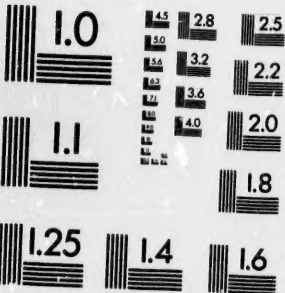


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G. M. DAWSON, C.M.G., LL.D., F.R.S., DIRECTOR

CONTRIBUTIONS
TO
CANADIAN PALÆONTOLOGY

VOLUME IV

PART I

A REVISION OF THE GENERA AND SPECIES OF CANADIAN PALÆOZOIC CORALS
The Madreporaria Perforata and the Alcyonaria

BY

LAWRENCE M. LAMBE, F. G. S.

Assistant Palæontologist

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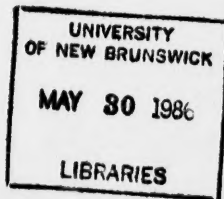


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Corals, as is well known, form a large proportion of the fossils found in the Palæozoic rocks of Canada. Unfortunately, however, the classification and nomenclature of these corals have long been in a state of some confusion. With a view to remedying this, Mr. Lambe has, at Mr. Whiteaves's suggestion, undertaken a revision of the genera and species.

The present report on the Madreporaria Perforata and the Alcyonaria, with five plates, forms the first part of the fourth volume of "Contributions to Canadian Palæontology". A second part, now in course of preparation and to be illustrated by thirteen plates, is intended to conclude the revision of this class so far as present material permits.

GEORGE M. DAWSON.

GEOLOGICAL SURVEY DEPARTMENT.
OTTAWA, October, 1899.

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GEOLOGICAL SURVEY OF CANADA.

CONTRIBUTIONS TO CANADIAN PALEONTOLOGY.

VOLUME IV.

PART I.

A REVISION OF THE GENERA AND SPECIES OF CANADIAN
PALÆOZOIC CORALS.

The Madreporaria Perforata, and the Alcyonaria,

BY

LAWRENCE M. LAMBE.

The following pages consist of a revision of the genera and species of Canadian Palæozoic corals, with as complete a description as possible of their structural characteristics. The classification of the corals in the first volume of Nicholson and Lydekker's Manual of Palæontology has been for the most part adhered to and, in most cases, original descriptions of the genera and species, as the writer understands them, have been prepared. As far as the material available will permit, the various genera of the *Madreporaria Perforata* are taken up in order and later those of the *Alcyonaria*. At a future time it is hoped to complete a revision of the *Actinozoa* by a similar treatment of the remaining sections of the *Zoantharia*. It is attempted to show that some forms hitherto considered of little value as regards the determination of the age of the deposits in which they occur, on account of their wide range in geological time, are capable of indicating definite horizons through the possession of distinctive structural peculiarities. The advances made in palæontology of recent years and the new light thrown on some doubtful points of structural detail, through the medium of additional and sometimes better preserved material, have either necessitated the removal of some species to different genera or have strengthened others in the positions already assigned to them.

All the fossils mentioned in the following pages with few exceptions are in the collection of the Geological Survey Department at Ottawa and are the result of many years collecting in all parts of the Dominion by officers of the Survey.

The writer takes this opportunity of expressing his thanks to Mr. Whiteaves for critical suggestions made during the progress of this report, and to Professor H. Alleyne Nicholson for the loan of a number of types of Canadian species of fossil corals described in the two "Reports upon the Palæontology of Ontario" and in his "Palæozoic Tabulate Corals."

ACTINOZOA.

ZOANTHARIA.

1. Madreporaria Perforata.

FAVOSITIDÆ.

GENUS FAVOSITES, Lamarck, 1816.

(Hist. des An. sans. Vert., vol. II., p. 204.)

- Calamopora*, Goldfuss. 1826. Petrefacta Germaniæ, vol. I., p. 77.
Emmonsia, Milne-Edwards and Haime. 1851. Polyp. Foss. des Terr. Palæoz., p. 246.
Astrocerium, Hall. 1851. Palæon. New York, vol. II., p. 120.

Corallum of variable shape, massive or branching, composed of contiguous, prismatic, polygonal corallites, that are placed in communication with each other by circular mural pores; walls thin and bearing on their inner surface spiniform septa or squamule; tabule numerous, complete, horizontal; basal attachment small; lower surface covered by an epitheca.

In this genus the corallum may be discoidal, hemispherical, spherical, lobate, digitate or clavate, with numerous modifications, and also ramose. The corallites are in close contact with each other, without a complete amalgamation of the walls, and are either polygonal, subpolygonal or circular; they emerge at right angles to the surface and in the ramose forms diverge outward from an imaginary central axis; they are either equal or subequal, or are distinctly of two sizes, in which latter case the larger ones are subangular or circular, and the smaller ones polygonal. Septa are represented by tubercles or spines, arranged in vertical rows or irregularly distributed, or by horizontal, tongue-shaped processes (squamule) also occurring in rows. The mural pores are placed in the sides of the corallites, or close to or in the angles; in the former case they occur in one, two or three definite vertical rows or are disposed without order. Longitudinal striations sometimes occur on the inner surface of the walls, one to each space between the rows of pores. Although the walls of the corallites are typically thin, a decided thickening is at times observable. Opercula are present, in some species, closing

expressing his thanks to Mr. [?], for the progress of this report, and the loan of a number of types and in the two "Reports upon Paleozoic Tabulate Corals."

rata.

, 1816.

II., p. 204.)

ol. I., p. 77.

Foss. des Terr. Paléoz., p. 246.

p. 120.

encing, composed of concentric plates placed in communication with each other, thin and bearing on their outer surface numerous, complete, rounded, subpolygonal or circular, subpolygonal or circular, surface covered by an

hemispherical, spherical, or conical, and also ramose. The corallites, without a complete septal axis; they are either in the ramose case in which latter case the smaller ones polygonal. The corallites are arranged in vertical rows or tongue-shaped processes; the pores are placed in the rows; in the former case the pores are disposed in rows or are disposed on the inner surface of the rows of pores. In some species, closing

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the calyces. The tabulae are frequently crenulated, or have more or less well defined depressions at the margin.

As has been already pointed out by Rominger,* all Cambro-Silurian or Silurian species of this genus have spiniform septa whilst those of the Devonian have squamulae.

FAVOSITES GOTHLANDICA, Lamarck.

Plate I., fig. 1.

- Favosites Gothlandica*, Lamarck. 1816. Hist. des An. sans Vert., vol. II., p. 206.
 " " Goldfuss. 1829. Petrefacta Germaniae, pl. XXVI., figs. 3a, 3e.
Favosites favosa, Goldfuss. 1829. Ibid., pl. XXVI., figs. 2a-c.
Favosites Gothlandica, Lonsdale. 1839. Murch. Sil. Sys., p. 682, pl. 15 bis, figs. 3, 3a and 4.
 " " Milne-Edwards and Haime. 1851. Polyp. Foss. des Terr. Paléoz., p. 232; and 1855, Brit. Foss. Corals, p. 256, pl. LX., figs. 1, 1a.
 " " McCoy. 1855. Brit. Paléoz. Foss., p. 20.
 " " Billings. 1863. Geology of Canada, p. 305, fig. 302; and 1866, Cat. Sil. Foss. of Anticosti, p. 32.
 " " Nicholson. 1875. Palæon. of Ont., p. 51.
Favosites favosa, Nicholson. 1875. Ibid., p. 52.
Favosites Gothlandica, Nicholson. 1875. Palæon. of Ohio, vol. II., p. 224.
Favosites favosa, Nicholson. 1875. Ibid., p. 229.
Favosites favosus, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 2^a, pl. IV., figs. 1-4 and pl. V., fig. 2.

Corallum growing in subhemispherical, discoid or irregularly shaped massive expansions generally with a more or less convex upper surface; basal portion covered by a concentrically wrinkled and finely striated epitheca. Corallites prismatic, generally rather equal in the same specimen, varying in different individuals from about 2 or even less to 5 mm. wide. Pores circular, surrounded by a slightly raised rim, in one, two or three rows in the sides of the corallites; averaging from about .25 to .33 mm. in diameter. Tabulae complete, flat, at times concave or convex, and varying considerably, even in the same specimen, in their distances apart from each other; they frequently exhibit concentric lines of growth. Marginal depressions or crenulations are often developed in the tabulae and in some specimens are very noticeable, extending for some distance toward the centre of the tabulae; in the same specimen these crenulations may be well marked in some of the tabulae and altogether wanting or but slightly formed in others. Short, close set, sharply pointed septal spines project inward, with frequently a slight upward inclination, from the walls of the corallites; sometimes they are arranged apparently without order, at other times in more or less definite longitudinal rows.

* Geological Survey of Michigan, Fossil Corals, p. 19. 1876.

F. Gothlandica occurs at numerous localities in the Niagara, Guelph and Lower Helderberg formations, in divisions 2, 3 and 4 of the Anticosti group and in rocks of supposed Hudson River age at Stony Mountain, Manitoba. The specimens in the collection are from the following localities—in the Niagara from Thorold, Ont., E. Billings; Rockwood, Ont., R. Bell, 1861; Owen Sound, Ont., J. Townsend, 1874; Grand Manitoulin and Cockburn Islands, Lake Huron, R. Bell, 1866; Drummond Island, Lake Huron; at the north end of Lake Temiscaming, Que., R. Bell, 1877 and A. E. Barlow, 1883, 1884; in the Guelph from Galt, Ont., R. Bell, 1861; in the Lower Helderberg from l'Anse au Gascon, Baie des Chaleurs, R. Bell, 1862; l'Anse à la Vieille and l'Anse à la Barbe, Baie des Chaleurs; in divisions 2, 3 and 4 of the Anticosti group from various localities, J. Richardson, 1856 and Professor John Macoun, 1883. The specimens from Stony Mountain were collected by T. C. Weston in 1884. Two small specimens were also collected on the east side of Mansfield Island, Hudson Bay by R. Bell in 1884 from rocks that have been doubtfully referred to the Niagara. A number of specimens were obtained by A. P. Low at Limestone Rapids on the Fawn branch of the Severn River in 1886 in rocks which are supposed to be "not older than the Galena and may be as new as the Niagara." *

In 1894 specimens were obtained at Fort Churchill, Hudson Bay, by J. B. Tyrrell, in rocks that have been referred to as of Cambro-Silurian age.

In addition to the above localities *F. Gothlandica* was collected in rocks of Silurian age at Davis Point, Lake Manitoba, by J. B. Tyrrell, 1888, and at the west side of Cedar Lake, at Cross Lake Rapids and at Grand Rapids, Saskatchewan River near its mouth by J. B. Tyrrell, 1890; also at a slightly lower geological horizon, a few miles south of Long Point (station 1030), Lake Winnipeg by D. B. Dowling, 1891.

FAVOSITES ASPERA, d'Orbigny.

Plate I, fig. 2.

- Favosites alveolaris*, Lonsdale. 1839. Murch. Sil. Sys., p. 681, pl. 15 bis, figs. 1, 1a., 1b and 2, 2a.
Favosites aspera, d'Orbigny. 1850. Prodr. de Paléont., vol. I., p. 49.
 " " Milne-Edwards and Haime. 1851. Polyp. Foss. des Terr. Paléoz., p. 234.
 " " Milne-Edwards and Haime. 1855. Brit. Foss. Corals, p. 257, pl. LX, figs. 3, 3a.
 " " McCoy. 1855. Brit. Paléoz. Foss., p. 20.

* Geological Survey of Canada, Annual Report, 1886, new series, p. 18 of Mr. Low's report.

localities in the Niagara, Guelph divisions 2, 3 and 4 of the Anticosti River age at Stony Mountain, section are from the following
 Ont., E. Billings; Rockwood,
 t., J. Townsend, 1874; Grand
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 a Vieille and l'Anse à la Barbe,
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Gothlandica was collected in
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 y D. B. Dowling, 1891.

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p. 681, pl. 15 bis, figs. 1, 1a., 1b

vol. I., p. 49.

Polyp. Foss. des Terr. Palæoz.,

it, Foss. Corals, p. 257, pl. LX.,

20.

new series, p. 18 of Mr. Low's

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CANADIAN PALÆOZOIC CORALS.

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- Favosites prolificus*, Billings. 1865. Canadian Naturalist, 2nd series, vol. II., p. 429;
 and 1866, Cat. Sil. Foss. of Anticosti, p. 6.
Favosites (?) capax, Billings. 1866. Cat. Sil. Foss. of Anticosti, p. 6.
Favosites Niagarensis, Rominger (non Hall). 1876. Géol. Sur. Mich., Foss. Corals, p.
 22, pl. V., fig. 1.
Favosites aspera, Lebedeff. 1892. Obersilurische Fauna des Timan, p. 8, pl. I., figs. 1,
 a, b, c.
Favosites prolificus, Whiteaves. 1895. Palæoz. Foss., vol. III., pt. II., p. 113.

Corallum massive, attaining to a considerable size, subhemispherical or broadly expanding and agreeing in general external form with *Favosites Gothlandica*, Lamarck; upper surface generally convex, under surface as a rule rather flat, protected by an epitheca. Corallites prismatic, with an average width of nearly 2 mm., generally rather equal in the same specimen. Tabule complete, horizontal, often concavely or convexly bent, rather close together, generally from .5 to 1 mm. apart but frequently more distant and showing a considerable variation even in the same specimen. Small marginal pits or depressions in the tabule are sometimes developed in this species, but as a rule they are small and inconspicuous. Pores of moderate size, placed in or close to the angles of the corallites, in some specimens very numerous and about .75 mm. apart, sometimes encircled by a raised border. Occasionally pores are seen in the sides of the corallites, but this seems to be exceptional. Septal spines sharply pointed, as a rule short but capable, as is evinced by some specimens, of a much greater degree of development and becoming moderately long. In this species the septal spines are not so numerous as in the preceding and occur more generally in longitudinal rows.

The corallites of some specimens are very much below the average width of nearly 2 mm. being less than 1 mm., whilst in other specimens they are very unequal and vary in diameter from about .5 to 2 mm.

This species occurs in the Hudson River formation in Anticosti and at Stony Mountain, Manitoba, as well as at Stonewall, Manitoba, near the latter place; it is also found in the four divisions of the Anticosti group.

Specimens of a *Favosites* have also been collected at East Selkirk and Lower Fort Garry, Manitoba, that are doubtfully referred to this species; they do not show the pores although otherwise the structure is well preserved. The rocks at these localities have been assigned by Mr. Whiteaves to the Galena-Trenton so that if through the medium of other specimens from these places the pores are found to be situated at the angles of the corallites, the downward extension of the range of *Favosites aspera* will be considerable.

The largest specimen in the museum is from Stony Mountain and was collected by R. W. Ellis in 1875; it is 10 inches broad, 2½ inches in

maximum thickness or height and is a portion only of the entire corallum.

Specimens of *Favosites aspera* were collected in the Silurian (Niagara) near the mouth of the Saskatchewan River at Roche Rouge by J. B. Tyrrell in 1890, and a little lower down the river at Grand Rapids by D. B. Dowling in 1891; also in the Cambro-Silurian at a locality (station 1030) a few miles south of Long Point, Lake Winnipeg, by D. B. Dowling in 1891.

FAVOSITES HISINGERI, Milne-Edwards and Haime.

- Favosites Hisingeri*, Milne-Edwards and Haime. 1851. Polyp. Foss. des Terr. Palæoz., p. 240, pl. XVII., figs. 2, 2a, 2b.
Astrocerium venustum, Hall. 1852. Palæon. New York, vol. II., p. 120, pl. 34, figs. 1a—j.
Astrocerium parasiticum, Hall. 1852. Ibid, p. 122, pl. 34, figs. 2a—i.
Astrocerium pyriforme, Hall. 1852. Ibid, p. 123, pl. 34 A, figs. 1a—c.
Favosites Hisingeri, Milne-Edwards and Haime, 1855. Brit. Foss. Corals, p. 259, pl. 61, figs. 1, 1a, 1b.
Calamopora venusta, Rominger. 1862. Am. Jour. Sci. and Arts, 2nd series, vol. XXXIV., p. 394.
Favosites venusta, Nicholson. 1875. Palæon. of Ont., pp. 52 and 65.
Favosites venustus, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 22, pl. V, fig. 3.
Favosites Hisingeri, Whiteaves. 1895. Palæoz. Foss., vol. III., pt. II., p. 51.
Astrocerium venustum, Whitfield. 1882. Geol. of Wisconsin, vol. IV., p. 270, pl. XIII., figs. 8, 9, 10.

Corallum forming massive expansions of irregular shape, attaining a considerable size but seldom more than 2 or 3 inches in thickness; lower surface protected by an epitheca. Corallites prismatic, small, varying in diameter from .5 to 1.5 mm. across in the same specimen. Septal spines numerous, sharply pointed, long, reaching to or almost to the centre of the corallites, generally curved slightly upward and arranged in longitudinal rows. Pores of moderate size, occurring in one or two rows in the sides of the corallites. Tabule flat, horizontal, about from two to four in a space of 1 mm.

This species differs from *F. Gothlandica* in the smallness of its corallites and the much greater length of the septal spines; from *F. aspera*, in which the septal spines are frequently of considerable length, it is easily recognized by the pores being placed in the sides instead of at or near the angles of the corallites and by the smaller size of the corallites in average specimens.

Favosites hispida, Rominger,* is a form which differs from *F. Hisingeri*, as generally understood, only in a slight increase in the diameter of the

Geological Survey of Michigan, Fossil Corals, p. 22, pl. V., fig. 4. 1876.

ion only of the entire

n the Silurian (Niagara)
Roche Rouge by J. B.
ver at Grand Rapids by
-Silurian at a locality
Lake Winnipeg, by D. B.

s and Haime.

olyp. Foss. des Terr. Paleoz.,

vol. II., p. 120, pl. 34,

figs. 2a-i.

figs. 1a-e.

Foss. Corals, p. 259, pl. 61,

and Arts, 2nd series, vol.

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ers from *F. Hisingeri*,

the diameter of the

, fig. 4. 1876.

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CANADIAN PALEOZOIC CORALS.

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corallites which, in the former species, are described as being a little over 1.5 mm. wide. The difference in the size of the corallites in the two species is so slight that the writer is inclined to regard *F. hispida* as not specifically distinct from *F. Hisingeri*, but rather as a form of the latter in which the corallites are a trifle larger than the average.

Occurs in the Niagara and Guelph formations in Ontario; on Cockburn and Drummond Islands, Lake Huron and at Thoroid (Niagara); at Elora and near Durham, lot 16, concession 1, Bentinck township, county of Grey (Guelph).

FAVOSITES NIAGARENSIS, Hall.

(Non *F. Niagarensis*, Rominger.)

Favosites Niagarensis, Hall. 1852. Paleon., New York, vol. II., p. 125, pl. 34A bis, figs. 4a-i.]

A number of specimens of a favosite coral, in the collection of this survey, from rocks of presumably Lower Helderberg age are here referred to this species; they have been collected, by officers of the survey at various dates since 1858, between Cap des Rosiers and Cape Gaspé, at Cap Bon Ami, Gaspé, on the Matapedia and Restigouche rivers, at one mile east of the Little Cascapedia River and at Cap Bon Ami, N.B., near Dalhousie. These specimens are either spherical or clavate, with gradations between these forms, and seem generally to have had a small basal attachment. The corallites are rather unequal in size and vary in diameter from .5 mm. to slightly over 2 mm. The tabulae are well preserved, regular and complete, from about five to ten occurring in a space of 5 mm. The sides of the corallites are beset with small spiniform septa and are pierced by one or two rows of pores. In one specimen from Cap Bon Ami, Gaspé, the coral, beginning with a basal diameter of 2 cent., increases in thickness slowly for some distance upward, then expanding more rapidly, reaches a diameter of nearly 6 cent. near the top and is rather regularly rounded above; the total height of the specimen is 22 cent.

The Canadian coral agrees with the one described by Hall, in having corallites that are smaller than those of *F. Gothlandica*, in the position of the pores in the sides of the corallites and in the small basal point of attachment of the corallum. Its general contour is often spherical but frequently becomes higher than broad and sometimes clavate. In the description of *F. Niagarensis* the corallum is stated to be spherical or irregular in form.

In describing *Favosites Helderbergiae**, Hall states that it "differs from *Favosites Niagarensis*, which it resembles in the size of its cells, in

* Paleon. New York, vol. VI., p. 8, 1887.

having more numerous diaphragms and in the mural pores being on the lateral faces instead of at the angles of the cells." This last distinction disappears when we consider that *F. Niagarensis* is described as having pores "distinctly visible in the sides of the cells," and the figures of this species* would lead to the belief that the distances apart of the tabulae are very variable. The only difference then between *F. Helderbergiae* and *F. Niagarensis* appears to be in the shape of the corallum which in the former species is "large, lenticular, depressed convex or hemispherical," and in the latter spherical or clavate, a difference which though slight, may be considered sufficient, if it be constant, for the separation of the two species.

FAVOSITES GASPENSIS. (Sp. nov.)

Corallum subdendroid or irregularly lobate with polygonal calyces opening on the entire surface; branches or lobes compressed laterally and varying in their lesser diameter from over 20 to less than 8 mm. The corallites radiate from an imaginary central axis and emerge at right angles to the surface; they are thin walled, polygonal in section and rather unequal in size but average nearly 3 mm. in width with a few that are somewhat larger. Walls of the corallites pierced by one or two rows of circular pores and carrying on their inner surfaces numerous short septal spines. Tabulae complete, horizontal, about .5 mm. apart.

This species is of interest on account of the shape of the corallum and of the large size of the corallites; it bears some resemblance, particularly in the size of the corallites, to the branching coral *Favosites cervicornis*† (Can. Jour., new series, vol. IV., p. 110, fig. 9) from the Corniferous of Ontario, but differs therefrom in several particulars especially, as all Silurian corals of this genus do from those of the Devonian system, in having septal spines instead of squamulae.

One specimen from l'Anse au Gascon, Baie des Chaleurs, Que.; collected by R. Bell in 1862. Lower Helderberg formation.

FAVOSITES BASALTICA, Goldfuss. (Sp.)

Plate I., figs 3, 3a.

Calamopora basaltica (pars), Goldfuss. 1829. Petrefacta Germaniæ, vol. I., p. 78, pl. XXVI., fig. 4a (cæt. exclusis).

Favosites Gothlandica, Billings. 1859. Canadian Journal, new series, vol. IV., p. 104, figs. 2, 3, 4.

Favosites basaltica, Billings. 1859. Ibid, p. 106, fig. 8.

* Op. cit., pl. 34 A bis, figs. 4b, 4e, 4f.

† Vide, p. 12.

the mural pores being on the cells." This last distinction *ensis* is described as having cells," and the figures of this instances apart of the tabulae between *F. Helderbergiae* of the corallum which in pressed convex or hemi-clavate, a difference which if it be constant, for the

p. nov.)

ce with polygonal calyces es compressed laterally and 0 to less than 8 mm. The axis and emerge at right polygonal in section and n. in width with a few that pierced by one or two rows r surfaces numerous short out 5 mm. apart.

shape of the corallum and resemblance, particularly *Favosites cervicornis*†) from the Corniferous of iculars especially, as all the Devonian system, in

Chaleurs, Que.; collected on.

ss. (Sp.)

Germania, vol. I., p. 78, pl.

, new series, vol. IV., p. 104,

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CANADIAN PALEOZOIC CORALS.

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- Calamopora epidermata*, Rominger. 1862. Am. Jour. Sci. and Arts, 2nd Series, vol. XXXIV., p. 396.
Favosites Gothlandica, Nicholson. 1874. Palæon. of Ont., p. 45, (with reference only to the coral from the Corniferous limestone and Hamilton formation).
Favosites Forbesi, Nicholson. 1874. Palæon. of Ont., p. 48, pl. VII, fig. 8 and pl. VIII., fig. 4.
Favosites Forbesi, var. *tuberosa*, Nicholson. 1879. Palæoz. Tab. Corals, p. 62, pl. III., figs. 2, 2a-c.
Favosites epidermatus, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 28, pl. VIII., figs. 1, 2, 3.
Favosites tuberosus, Rominger. 1876. Ibid, p. 30, pl. IX., figs. 1, 2.
Favosites tuberosa, Hall. 1876. Illus. Dev. Foss., pl. VIII., figs. 1-7, pl. VI., fig. 6 and pl. XI., fig. 1; *ibid*, var. pl. I., fig. 1, pl. IV., fig. 1, and pl. VII., fig. 1.
Favosites epidermata, Hall. 1876. Illus. Dev. Foss., pl. VI., figs. 1-5 and pl. XII., figs. 6, 9-13; *ibid*, var. *corticosa*, pl. X., figs. 1-6 and pl. XI., figs. 11, 12.
Favosites tuberosa, Whiteaves. 1889. Contr. to Can. Palæon., vol. I., pt. II., p. 121.

Corallum forming irregularly shaped, more or less spreading masses, often with flat or sublobate minor expansions proceeding from the upper surface, or the general form may be hemispherical, subspherical, pyriform, lobate, clavate or even subramose; basal attachment small. Under surfaces and often the sides protected by a strong wrinkled epitheca; the wrinkles are generally rather irregularly disposed and overlap or run into each other, but in some specimens they are more nearly parallel and give to the epitheca a ribbed appearance. The basal portion of the corallum is frequently strongly plicated. The ends of the corallites, when directed upward or outward, except at the top of the corallum, are generally closed by opercula which show a certain amount of concentric structure. The corallites are generally prismatic and rather equal in size when the surface of the corallum is moderately flat but round and unequal in size in specimens or parts of specimens where the surface is rounded; varying in diameter in the same colony or in different individuals from 2 mm., or even less, to 4 or 5 mm. Tabulae horizontal, complete, sometimes apparently formed by the union of several squamulae which are present in large numbers. Pores piercing the sides of the corallites in from one to three longitudinal rows, in some specimens large and placed close together, in others smaller and farther apart, generally surrounded by a raised rim which is frequently not preserved on much weathered surfaces. Inner surface of the corallites marked, with varying distinctness, by longitudinal impressed lines, one to each space, between the rows of pores.

This coral is subject to much variation in outward form, in the size and number of the mural pores and in the size and shape of the corallites themselves, whilst its appearance is much affected by the state of preservation of the epitheca and of the tabulae and squamulae, especially the

last, which are frequently not preserved, leaving the walls of the corallites on the inside quite smooth.

The squamulae occur one above another in longitudinal rows corresponding in a general way with the rows of pores, those of one row frequently interlocking with those of another. When the mural pores are numerous the squamulae are generally placed one above each pore, but, when fewer in number and farther apart, two or three squamulae are found occupying the space between any two pores of a longitudinal row. From this it would appear that the squamulae may be equally numerous when the pores are distant from each other or when they are placed close together. Most frequently the squamulae have their bases only preserved but under favourable circumstances they are seen to reach the centre of the corallite in the form of thin tongue-shaped processes that are longer than broad and at times inclined slightly upward.

In different coralla the pores vary in diameter from about .33 to .50 mm., and in their distance from each other; in some specimens, especially in those in which the pores are large, they are about .50 mm. from each other, whilst in others they are as much as 2 mm. apart vertically. In most cases the absence of the raised border of the pores is probably due to weathering, as examples occur in which the rim is present in certain portions of the corallum and absent in more exposed parts; in the case of the latter the pores appear larger than they really are.

As in some other species of the genus, small marginal depressions in the tabulae are not unfrequently developed.

Broadly expanded examples sometimes measure nearly 9 inches across with a height of 3 or 4 inches; clavate specimens occur that are 10 or more inches high and a few inches thick; some of the pyriform specimens are 6 or 7 inches high and 5 or 6 inches in breadth.

The large collection of specimens of this species in the museum of the Geological Survey has enabled the writer to study the many transitional stages between examples with large close set pores, which are undoubtedly the *F. tuberosa* of Rominger, and others that agree in every particular with *F. epidermata*, Rominger.

Abundant in the Corniferous formation of Ontario.

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FAVOSITES HEMISPHERICA, Milne-Edwards and Haime. (Sp.)

- Favosites alveolaris*, Hall. 1843. Geol. of New York, p. 157, No. 13, figs. 1, 1a.
Emmonsia hemispherica, Milne-Edwards and Haime. 1851. Polyp. Foss. des Terr.
Palæoz., p. 247.
" " Milne-Edwards and Haime. 1853. Brit. Foss. Corals, p.
218, pl. XLVIII., figs. 4, 4a.
Calamopora hemispherica Rominger. 1892. Am. Jour. Sci. and Arts, 2nd Series, vol.
XXXIV., p. 394.
Favosites hemispherica Billings. 1859. Canadian Journal, new series, vol. IV., p.
105, figs. 5, 6, 7.
" " Nicholson. 1874. Palæon. of Ont., p. 49, pl. VIII., fig. 3.
Favosites (Emmonsia) hemispherica, Nicholson. 1879. Palæoz. Tab. Corals, p. 67,
fig. 15, pl. III., figs. 3, 3a, 3b.
Favosites Emmonsii, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 26, pl. VII.,
figs. 1, 2.
" " Hall. 1876. Illus. Dev. Foss., pl. IX., figs. 1-6; pl. XI, fig.
5; pl. XII., figs. 1-5.
Favosites hemispherica, Whiteaves. 1889. Contr. to Can. Palæon., vol. I., pt. II,
p. 121.

Corallum forming large masses, sometimes nearly 1 foot across and
over 4 inches in thickness or height. Corallites prismatic, rather un-
equal in size, varying from 1 to 2.5 mm. in diameter in the same speci-
men. Pores with raised margins, in one, two or three rows in the sides
of the walls of the corallities, placed close together; about .2 mm. in dia-
meter and .50 mm. apart. Tabulae apparently absent. Squamulae very
numerous, one above each pore, reaching to and often past the centre of
the corallites, frequently inosculating, thin at the edge with strong
bases, about .50 mm. apart vertically and often inclined slightly upward
or downward; those of one row generally alternating and interlocking
with those of another.

Complete tabulae seem to be wanting, but as in *Favosites basaltica* the
union of several squamulae, on about the same level, may result in the
production of an undulating and rather imperfect partition across the
corallite.

This species differs from *F. basaltica*, Goldfuss, in the apparent
absence of true tabulae and in the somewhat more numerous squamulae,
although if a comparison be made with some specimens of *F. basaltica*
in which the pores and squamulae are abundant, the difference is seen to
be so slight as to make it doubtful whether *F. hemispherica* is really
distinct from *F. basaltica*; perhaps it would be better to regard it
rather as a variety of *basaltica* than as a distinct species. In 1859, in
the Canadian Journal, vol. IV., p. 108, Mr. Billings expressed a doubt
as to whether the two species are really separable.

Occurs in the Corniferous limestone of Ontario.

FAVOSITES CANADENSIS, Billings. (Sp.)

- Fistulipora Canadensis*, Billings. 1858. Rep. of Progress for 1857, Geol. Survey of Canada, p. 165; and 1858, Canadian Naturalist, vol. III., p. 420; also 1859, Canadian Journal, new series, vol. IV., p. 98, fig. 1.
- Calanopora Canadensis*, Rominger. 1862. Am. Jour. Sci. and Arts, 2nd series, vol. XXXIV., p. 397.
- Fistulipora Canadensis*, Nicholson. 1874. Palæon. of Ont., p. 63.
- Favosites Canadensis*, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 29, pl. VIII., fig. IV and pl. XV., fig. 3.
- " " Whiteaves. 1889. Contr. to Can. Palæon., vol. I., pt. II., p. 121.

Corallum forming large spreading masses with an undulating or irregularly nodular upper surface and a concentrically striated epitheca covering the basal portion; frequently 3 or 4 inches in thickness and 1 foot in diameter. In the most typical specimens there is a differentiation of the corallites into comparatively large rounded or almost circular tubes, at an average distance of about 4 mm. apart, and smaller prismatic tubes in the intervals. In portions however of the same specimens the difference in the shape and size of the two forms of corallites may be less apparent or may disappear altogether, whilst in some individuals prismatic corallites, having an average diameter of about 1 mm., alone occur; the circular corallites are from 1 to nearly 2 mm. in diameter. Pores small, about .17 mm. in diameter, close together, about .33 mm. apart vertically, in one, two or three rows in the sides of the corallites. Tabulæ horizontal, entire. Squamule abundant, of the usual tongue-like shape, passing to the centre and frequently combining to form pseudo-tabulæ.

Found in the Corniferous limestone of Ontario. According to Rominger this coral has at times a "digitato-ramose or reticulated growth with orifices on all sides of the stems."

FAVOSITES CERVICORNIS, Milne-Edwards and Haime.

- Favosites cervicornis*, Milne-Edwards and Haime. 1851. Polyp. Foss. des Terr. Palæoz., p. 243.
- " " Milne-Edwards and Haime. 1855. Brit. Foss. Corals, p. 216, pl. XLVIII., fig. 2.
- " " Billings. 1859. Canadian Journal, new series, vol. IV., p. 110, fig. 9.
- " " Nicholson. 1874. Palæon. of Ont., p. 52.
- ? *Favosites arbuscula*, Hall. 1876. Illus. Dev. Foss., pl. XXXVI., figs. 1-9.
- Pachypora cervicornis*, Whiteaves (pars). 1891. Contr. to Can. Palæon., vol. I., pt. III., p. 206.

Corallum with rather short, stout, bifurcating, cylindrical branches growing upward from a stout base or rising independently from a common, almost lamellar base; the branches are often somewhat compressed laterally in their upper portions, sometimes rather globose or thickened, and are

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progress for 1857, Geol. Survey of
Canadian Naturalist, vol. III., p. 420;
new series, vol. IV., p. 98, fig. 1.
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CANADIAN PALÆOZOIC CORALS.

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evenly rounded above. A thin epitheca covers the lower part of the corallum and extends for some distance up the branches. Within, the corallites diverge obliquely outward and upward from an imaginary axial line and terminate at right angle or rather obliquely to the surface; they are moderately thin walled throughout their length and polygonal in section, but in some cases, the walls become quite stout. Calyces unequal in size, generally with smaller ones dispersed between the larger ones; varying in diameter in the same specimen from 2 mm., or even slightly more, to 1 mm. Pores not very numerous, of moderate size, in one or sometimes two rows in the sides of the corallites. Tabule horizontal, complete. Inner surfaces of the walls bearing numerous, horizontal, lamellar squamulae that project only a short distance into the corallites. In the basal part of the corallum the outlines of the calyces are clearly defined in the epitheca which is also roughened by irregular, raised, horizontal ridges.

Two specimens from Ontario show the low bushy shape of the corallum well; one is slightly over 7 cent. high, nearly 13 cent. broad with nine main subdivisions which during life were apparently about to bifurcate; the other is nearly 11 cent. high, 16 cent. broad with about the same number of stems or main branches, each of which subdivides two or three times.

Found in the Corniferous formation of Ontario, and of the Moose River district. The specimens in the collection of the survey from Ontario are from the township of Walpole, Haldimand county and from the township of Wainfleet in the county of Welland. One specimen was collected in 1888 by R. G. McConnell at the "Ramparts" McKenzie River (Devonian).

FAVOSITES CLAUSA, Rominger.

- Favosites clausus*, Rominger. 1876. Geol. Sur. of Mich., Foss. Corals, p. 36, pl. XIV.
Favosites clausa, Nicholson. 1879. Palæoz. Tab. Corals, p. 75, pl. IV., figs. 1—10.
" " Whiteaves. 1889. Contr. to Can. Paleon., vol. I., pt. II., p. 121.

This species is described by Rominger as consisting of "Clustered, rapidly branching and anastomosing flexuous stems, varying from one-half to one centimeter in thickness. Tubes unequal, the larger ones circular, measuring in different specimens from one-half to one and a half millimeter in diameter; the smaller tubes filling the interstices between the larger ones are subangular. Orifices at the ends of the branches all open; on the sides of the stems most of them are found closed by opercula. Opercula flat or convex, some of them decorated with twelve marginal carinae radiating toward the centre. Diaphragms partly simple and regular, but largely intermingled with irregular partial septa, formed

by the development of lateral squamæ analogous to the vertical rows of leaflets in other species of *Favosites*. Pores numerous."

This species differs from *F. nitella*, Winchell only in its mode of growth: in *F. clausa* the corallum is dendroid, in *F. nitella* it is generally arborescent, but sometimes digitato-ramose. In the original description* of the latter species it is said to occur in "small masses varying from globoid to elongate or scarcely branching."

Whether *F. clausa* is really distinct from *F. nitella* is a question which can only be solved by the study of a large series of specimens showing the variation in form of the corallum in both species; such a series is not at present available to the writer.

The specimens in the collection of the survey are from the Hamilton formation of Ontario, at Thedford and vicinity, in the township of Bosanquet, and from the Aux Sable River; and from the Corniferous at Cayuga, Ont.

FAVOSITES RADICIFORMIS, Rominger.

Favosites radiformis, Rominger. 1876. Geol. Sur. Mich., Fossil Corals, p. 33, pl. XII., figs. 1, 2.

"Cylindrical and apparently procumbent creeping stems of variable thickness, from the diameter of a finger to that of a man's wrist, and often several feet in length, with anastomosing or straddling branches. Tubes of two sizes—the larger ones circular, from one to one and a half millimeter wide, the smaller ones angular, filling the interstitial spaces between the larger tubes. Walls stout. Diaphragms rarely regular, straight, usually complicated with the rows of lateral squamæ." "Pores large and moderately numerous. The terminal parts of the stems are always formed of comparatively thin-walled, regularly formed tube orifices. On the lateral faces of the stems, the orifices are often considerably narrowed and disfigured by incrustation of the tube walls, while the lateral pore channels retain their usual diameter, and become transformed into long vermicular ducts of nearly equal size with the principal tube channels. Such specimens are very unlike, in external appearance, those with normally formed tube orifices."

With this species are identified a few fragmentary specimens from the Corniferous limestone near Woodstock, Ont., collected by Alexander Murray in 1860, and two fragments from rocks of the same age at Long Portage, Missinaibi River to Moose Factory, R. Bell, 1877. In one of the specimens from Woodstock the openings of the corallites are very

*Winchell. 1886. Rep. Lower Penins. of Michigan, p. 89.

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much reduced in size by the excessive thickening of the walls. The specimens apparently belong to the older parts of the corallum and none of them show the terminal ends of the stems. This species appears to be closely allied to *Cladopora*, and might with propriety be placed in that genus.

FAVOSITES TURBINATA, Billings.

- 1 *Calamopora basaltica* (pars), Goldfuss. 1820. Petrefacta Germaniae, vol. I., p. 78, pl. XXVI., figs. 4c, 4d, (cont. exclusis).
- 2 *Calamopora hemispherica*, Troost. 1840. Fifth Geol. Rep., Tennessee, p. 72. Description inadequate; no figure.
- 3 *Favosites hemispherica*, Yandell and Shumard. 1847. Contr. to Geol. of Kentucky, p. 7.
- 4 *Favosites turbinata*, Billings. 1859. Canadian Journal, new series, vol. IV., p. 109; and 1860, *ibid.* vol V., p. 238, figs. 7, 7a.
- 5 *Calamopora turbinata*, Rominger. 1862. Am. Jour. Sci. and Arts, 2nd series, vol. XXXIV., p. 399.
- 6 *Favosites turbinata*, Nicholson. 1874. Palaeon. of Ont., p. 49, pl. VIII., figs. 1, 2.
- 7 *Favosites hemisphericus*, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 24, pl. VI., figs. 1, 2, 3, 4 and pl. X., fig. 2.
- 8 *Favosites hemispherica*, Hall. 1876. Illus. Dev. Foss., pl. II., figs. 1-5; *ibid.* var. a (subturbinate forms), pl. II A, figs. 1-7; *ibid.* var. pl. II B, fig. 8 and pl. III. fig. 1; *ibid.* var. *turbinata* pl. II B, figs. 1-7, pl. II C, fig. 5 and pl. IV., fig. 2; *ibid.* var. *recta*, pl. II C, figs. 1-4; *ibid.* var. *distorta*, pl. V., figs. 1-5.
- 9 *Favosites turbinata*, Whiteaves. 1889. Contr. to Can. Palaeon., vol. I., pl. II, p. 121.

Corallum normally turbinate with the apex of the cone as the initial point, but varying very considerably in shape; up to about 15 cent. in diameter. The corallum is almost invariably strongly curved for a short distance from the pointed base and expands more or less rapidly, at times so rapidly as to make the breadth much greater than the height. Or, the growth of the corallum may continue in an upward direction, without much increase in breadth, producing a club-shaped form which may be straight, curved or abruptly bent or twisted. The corallites curve outward from an imaginary central axis and emerge at or nearly at right angles to the surface; they are distinctly prismatic, of rather uniform size, from about 1 to over 2 mm. in diameter and are faintly striated transversely on the outside. In some specimens scattered tubes of a size noticeably larger than the average sized ones may be observed. The outer ends of the corallites over the whole of the surface of the corallum, except at or near the top, are closed by concentrically striated opercula which frequently exhibit about twelve crenulations or depressions at the edge. The opercular coverings appear to thicken and amalgamate with age and to then have the appearance of a rather thin, smooth epitheca in which the prismatic ends of the corallites can still be traced. The pores are more frequently arranged in a single than a double row in the sides of the corallites but their size and distance apart seem

to be subject to considerable variation. The tabulae are complete and are on an average, about 1.5 mm. apart, and in some specimens "squamulae" are seen to be present though never apparently in large numbers.

Abundant in the Corniferous and Hamilton formations of Ontario; found also in the Oriskany sandstone. The largest specimen in the museum is from the Corniferous; it was about 1 foot long when perfect and is over 5 inches in diameter at its broadest part. *Calamopora basaltica* of Goldfuss from the Eifel (pl. XXVI, figs. 4c, 4d, op. cit.) bears a strong resemblance in the size and curve of its corallites and the arrangement and size of the pores to *F. turbinata*, Billings. The specimen figured by Goldfuss is a fragment only, so that it is impossible to tell what the shape of the corallum was when entire, although the marked curve of the corallites might suggest a form similar to the typical one of *F. turbinata*.

In the enlarged drawing the pores are in a single row on two sides of the corallites and there is a partly double row on a third side, also in figure 4c the pores are shown in single and double rows. The tabulae are apparently complete.

If, at any future time, it is found that *F. turbinata* is the same specifically as the coral represented by Goldfuss in these two figures, the name *turbinata* would still remain in use as the other form of *Calamopora basaltica*, Goldfuss from Lake Erie (fig. 4a), which is in the writer's opinion conspecific with *F. epidermata*, Rominger and was evidently considered the type of the species by its author, as it is mentioned and figured first, should be known as *F. basaltica*, Goldfuss.

It is possible that the *Calamopora hemispherica* of Troost is conspecific with *F. turbinata* but the description is so indefinite as to render it a matter of conjecture whether the two belong to the same species or not. As the "Fifth Geological Report to the Twenty-third General Assembly of Tennessee" may be difficult of access to many it is thought advisable to give Troost's description in extenso; it is as follows:—"Calamopora hemispherica, nobis. The fossil to which I have applied the name of *hemispherica* occurs, so far as I have been able to observe, only in hemispherical masses. It is formed of tubes of such size that nine of them, placed the one next to the other, will occupy half an inch; they radiate from the centre towards the circumference. In the interior of the mass they are internally and externally prismatic, but the upper surface is so much incrustated, that their oral apertures have no regular shape. Some of these tubes (on water worn masses) project here and there, and are then internally as well as externally cylindrical, and not connected together; they may be mistaken for *Syringopora*. The transverse septa are flat, and the connecting pores placed in the middle of the sides."

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the tabulæ are complete and are in some specimens "squamulæ" only in large numbers.

Hamilton formations of Ontario; The largest specimen in the about 1 foot long when perfect in its broadest part. *Calamopora* KVI, figs. 4c, 4d, op. cit.) bears its corallites and the arrangement, Billings. The specimen that it is impossible to tell what although the marked curve of is the typical one of *F. turbinata*.

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turbinata is the same specimen in these two figures, the name of the other form of *Calamopora* (a), which is in the writer's Rominger and was evidently author, as it is mentioned and Goldfuss.

hemispherica of Troost is conspicuous indefinite as to render it a to the same species or not. Twenty-third General Assembly many it is thought advisable as follows:—"Calamopora have applied the name of *hemispherica*, only in hemispherical that nine of them, placed the branch; they radiate from the interior of the mass they are the upper surface is so much regular shape. Some of these there, and are then internally connected together; they may the septa are flat, and the con-

Yandell and Shumard in the "Contributions to the Geology of Kentucky" refer to Troost's fossil in the following words:—"Favosites *hemispherica*.—This fossil the most characteristic of the shell-beds, to which it is limited, is abundant on the Falls, and is found in masses of a hemispherical figure, which vary from one to ten inches in diameter. It is most commonly calcareous, though sometimes it is siliceous;" no further information regarding the structure is given.

Rominger states in his "Fossil Corals of Michigan" that "all the original specimens of Fav. hemisph. kept in Mr. Yandell's collections are identical with *Favosites turbinatus* of Billings." As to most paleontologists, however, definite descriptions with figures are often the only means available for the study of already described species, and as Billings has evidently given the first description with figures that places beyond doubt the identity of the fossil referred to, it appears best, to the writer at least, in the interests of science, that the name *turbinata* should be retained for this particular species.

FAVOSITES NITELLA, Winchell.

- Favosites nitella*, Winchell. 1866. Rep. Lower Pen. of Michigan, p. 89.
 " *nitella*, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 32, pl. XI, fig. 4.
Favosites placenta, Rominger. 1876. Ibid., p. 32, pl. XI, figs. 1, 2, 3.
 " " Hall. 1876. Illus. Dev. Foss., pl. XXXIV., figs. 10, 11 and pl. XXXV., figs. 1—12.
 " " Whiteaves. 1889. Contr. to Can. Palæon., vol. I., pt. II., p. 121.

Corallum small, discoid or at times digitate with a tendency to become nodose or to branch. When discoid the coral expands laterally from a basal initial point of attachment, and rarely exceed 5 inches in diameter and between $1\frac{1}{2}$ inch and 2 inches in height; the edges are thin, the upper surface flat or undulating, at times nodose, the lower surface generally uneven, covered by a concentrically wrinkled and finely striated epitheca. In gaps in the epitheca of the under surface, at the edges and sometimes on portions of the upper surface the ends of the corallites are closed by opercula. In the digitate forms the corallites incline outward from an imaginary axis and have their outer ends closed by opercula except at the top, or if the coralla or portions of them were prostrate or inclined as they appear to have been at times, opercula are seen on the lower surfaces only.

Corallites unequal in size, prismatic, with rather thick walls and rounded angles, varying in diameter from .50 to 1 mm. in the same corallum. In some specimens or at times in parts only, almost circular corallites about 1 mm. or slightly less in diameter are developed and are seen at varying intervals apart on the surface, the spaces between being

occupied by corallites of smaller size but of the usual shape. Pores rather large, about .33 mm. in diameter, from 1 to 1.5 mm. apart vertically and in a single row in the sides of the corallites. Tabulæ horizontal, complete; squamulæ present in small numbers and of the usual shape.

This species approaches most nearly to *Favosites Canadensis*, Billings, of the Corniferous limestone, from which it may be easily recognised principally by the small size and characteristic shape of the corallum, by the smallness of the corallites and by its having rather large pores in single rows as well as by the comparative fewness of the squamulæ.

Abundant in the Hamilton formation of Ontario.

FAVOSITES ALPENENSIS, Winchell.

Favosites Alpenensis, Winchell. 1866. Rep. Lower Pen. of Michigan, p. 88.

Favosites Hamiltonensis, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 27, pl. VII., figs. 3 and 4.

Favosites Hamiltonia, Hall. 1876. Illus. Dev. Foss., pl. XXXIV., figs. 1-9.

Favosites Gothlandica, Whiteaves (cf. F. Billingsii, Rominger, and F. Hamiltonia, Hall). Contr. to Can. Paleon. vol. I., pt. IV., p. 272.

Corallum massive, irregular in shape, attaining sometimes a diameter of about 1 foot with a height or thickness of 4 or 5 inches. Corallites prismatic, unequal in the same specimen, varying from 1 to 2.5 mm. in width. Pores of moderate size, about .25 mm. in diameter, occurring generally in one row, though sometimes in two rows in the sides of the corallites. A slightly raised margin is seen round many of the pores but this is evidently not a constant character as very frequently the edges of the pores are quite plain or even slightly depressed when weathering would not account for the change. Tabulæ complete, horizontal, at times slightly concave or convex; frequently exhibiting marginal depressions. Squamulæ few in number, rather small, narrow and rather short, extending only a short distance into the corallites. Inner surface of corallites faintly striated longitudinally.

This species is distinguishable from other Devonian *Favosites* principally by the size of the corallites whose sides have most frequently only one row of pores and by the fewness and small size of the squamulæ as well as the large number of well developed tabulæ.

Found in the "Middle Devonian*" of Lakes Winnipegosis and Manitoba.

Western shore of Dawson Bay, Lake Winnipegosis, J. W. Spencer, 1874, one specimen (loose) and at Whiteaves Point, Professor J. Macoun,

the usual shape. Pores to 1.5 mm. apart vertically. Tabulae horizontal and of the usual

Favosites Canadensis, Billings, may be easily recognised by the shape of the corallum, by the rather large pores in the sides of the squamulae.

rio.

shell.

Michigan, p. 88.

ch., Foss. Corals, p. 27,

XXIV., figs. 1-9.

inger, and *F. Hamiltonia*, pt. IV., p. 272.

g sometimes a diameter of 5 inches. Corallites from 1 to 2.5 mm. in diameter, occurring in rows in the sides of the corallites and many of the pores are very frequently the slightly depressed when the Tabulae complete, horizontally exhibiting marginal depressions. Marginal depressions small, narrow and close to the corallites. Inner

an *Favosites* principally most frequently only size of the squamulae as

Winnipegosis and

Winnipegosis, J. W. Spencer, and Professor J. Macoun,

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CANADIAN PALÆOZOIC CORALS.

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1875, one specimen (a portion of a large mass 1 foot in diameter); at a number of localities at the southern end of Dawson Bay, and also at St. 125 on the east side of Lake Winnipegosis, J. B. Tyrrell, 1889; and at Monroe Point, Lake Manitoba, J. B. Tyrrell and J. F. Whiteaves, 1888. These specimens are preserved in the dolomitic limestone of this region.

Mr. E. Billings and Professor Nicholson have expressed the opinion that *Favosites Gothlandica* is common to the Silurian and Devonian formations of Canada. It was on the strength of these determinations that Mr. Whiteaves identified the Manitoba specimens of *F. Alpenensis* with *F. Gothlandica*. Dr. Rominger however, has shown that the Silurian species may be distinguished by their spiniform septa and the Devonian forms by their squamulae.

FAVOSITES BILLINGSII, Rominger.

- Favosites Billingsii*, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 28.
Favosites Gothlandica, Nicholson. 1879. (not *F. Gothlandica*, Lamarck. 1816.) Palæoz. Tab. Corals, p. 46, but quoted on p. 56, from Arkona, Ont., as var. *Billingsii*, Rominger.
Favosites Gothlandica, var. *Billingsii*, Whiteaves. 1889. Contr. to Can. Palæon., vol. I., pt. II., p. 121.

Corallum growing in broadly expanding discs, of varying convexity above, with a small central base of attachment; under surface rather flat with irregular concentric ridges and covered by an epitheca marked by minute concentric lines. Corallites prismatic, unequal, with an average width of about 2.5 mm.; in some specimens a few dispersed corallites occur that are noticeably larger than the others and attain a maximum diameter of about 4 mm. Pores generally in one sometimes in two rows in the sides of the corallites; about .33 mm. in diameter and surrounded by a raised margin. Tabulae complete, horizontal, numerous, in distance apart varying from less than 1 mm. to 2 or 3 mm. and frequently exhibiting a varying number of marginal depressions. Squamulae present in small numbers only. Where the exterior of a corallite is exposed in a fractured surface it is seen to be delicately striated in a transverse direction.

The largest specimen seen by the author is 10 inches in diameter and 3 inches high but Dr. Rominger in his original description of the species records a diameter of 3 feet.

Abundant in the Hamilton formation of Ontario.

* Contr. to Can. Palæon., vol. I., pt. IV., p. 253.

FAVOSITES DIGITATA, Rominger.

Favosites digitatus, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 38, pl. XV., fig. 4.

Stichypera cervicornis, Whiteaves (pars). 1891. Contr. to Can. Palæon., vol. I., pt. III., p. 206.

" " Whiteaves. 1892. Contr. to Can. Palæon., vol. I., pt. IV., p. 273.

Corallum consisting of cylindrical or slightly flattened, irregularly branching stems varying in diameter from about 7 to 20 mm., or even more, and apparently seldom attaining to any great size. The terminal ends of the branches are sometimes slightly attenuated, at other times they are thickened and end abruptly. Corallites prismatic, not very thin walled. Calyces rather at right angles to the surface, somewhat unequal in size measuring from slightly over 2.5 to 1 mm. in diameter in the same individual; they radiate outward toward the surface in the manner usual in branching forms of this genus. Tabulæ horizontal, complete, apparently not numerous. Squamulæ well developed and abundant on the inner surfaces of the corallites. Pores of moderate size, in some specimens rather distant and irregularly disposed, in others inclined to form single rows.

Favosites digitata occurs in the Hamilton formation of Ontario, in the middle Devonian of Lakes Winnipegosis and Manitoba and the Devonian of the Mackenzie River basin; its nearest ally seems to be *F. cervicornis*, Milne-Edwards and Haime, of the Corniferous formation in Canada, from which it is distinguished by its much less robust and more straggling form of growth, by having fewer pores that apparently do not occur in regular rows, and by further slight differences in structure that are noticeable when specimens of the two species are compared side by side.

Devonian.—Thedford, Ont.; Lake Manitoba, Pentamerus Point, Big Sandy Point and east side of Narrows, J. B. Tyrrell, 1888; Lake Winnipegosis, Dawson Bay, J. B. Tyrrell, 1889; Hay River, forty miles above its mouth, R. G. McConnell, 1887 (one specimen), the "Ramparts" Mackenzie River, R. G. McConnell, 1888 (three fragments), Vermilion Falls, Peace River, R. G. McConnell, 1889 (one specimen).

GENUS ALVEOLITES, Lamarck, 1801.

(Syst. des An. sans Vert., p. 375.)

Corallum in the form of hemispherical or discoidal masses or irregularly shaped expansions of varying thickness, composed of more or less flattened, intimately united, thin walled corallites opening most frequently obliquely to the surface and connected by mural pores placed generally in the

omingers.

ch., Foss. Corals, p. 38, pl. XV.,

tr. to Can. Palæon., vol. I., pt.

Can. Palæon., vol. I., pt. IV., p. 273.

lightly flattened, irregularly about 7 to 20 mm., or even any great size. The terminal ly attenuated, at other times lites prismatic, not very thin e surface, somewhat unequal mm. in diameter in the same e surface in the manner usual horizontal, complete, appar- ope and abundant on the moderate size, in some speci- d, in others inclined to form

formation of Ontario, in the Manitoba and the Devonian ly seems to be *F. cervicornis*, us formation in Canada, from robust and more straggling apparently do not occur in ences in structure that are s are compared side by side. oba, Pentamerus Point, Big J. B. Tyrrell, 1888; Lake 889; Hay River, forty miles e specimen), the "Ramparts" three fragments), Vermilion one specimen).

ark, 1801.

, p. 375.)

discoidal masses or irregularly osed of more or less flattened, ing most frequently obliquely ores placed generally in the

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lateral angles; tabulæ complete, transverse or somewhat oblique; septa occurring as spines or longitudinal ridges, seldom in the form of squamulæ; attached centrally below and with a basal epitheca.

In the genus *Alveolites* there is no expansion of the corallites at the calyces nor is there any thickening of the walls near the surface. The calyces are typically subtriangular and oblique to the surface, although in some species this obliquity is less apparent, as is also the compression of the corallites. The pores and tabulæ, septal spines or squamulæ are as a general rule not so numerous as in *Favosites* whilst the development of longitudinal ridges forms one of the features which distinguish this genus from *Favosites* and suggests its near relationship to *Cladopora*.

ALVEOLITES LABECHEI, Milne-Edwards and Haime.

- Alveolites Labechi*, Milne-Edwards and Haime. 1851. Polyp. Foss. des Terr. Palæoz., p. 257.
 " " Milne-Edwards and Haime. 1855. Brit. Foss. Corals, p. 232, pl. LXI., figs. 6, 6a, 6b.
 " " Billings. 1866. Cat. Sil. Foss. of Anticosti, p. 33.

In division 3 of the Anticosti group at South Point, Anticosti, and in division 4 at South-west Point and at the Jumpers, Anticosti, is found in abundance an *Alveolite* which was identified by the late Mr. Billings with this species. An *Alveolite* similar in structure to the Anticosti one is found at Fossil Hill, Manitoulin Island, Lake Huron and at Skunk Island off the south-western end of Manitoulin Island, also a little further west at Point Detour and at Owen Sound, Ont. A small specimen which probably also belongs to this species was found at l'Anse au Gascon, Baie des Chaleurs, in rocks that have been assigned to the Lower Helderberg formation. The specimens from Skunk Island, Manitoulin Island, Point Detour and Owen Sound are from the Niagara formation, and those from Anticosti from the probable equivalent of that formation on the island.

A specimen that is thought to belong to this species was collected on the north-east side of Lake Winnipegosis (Station 227, No. 198) by J. B. Tyrrell, in 1889 (Silurian).

The corallum of the Canadian representatives of this species takes the form of a low spreading mass, attached centrally at the base, with a somewhat convex upper surface, and a flat concentrically wrinkled lower surface with a thin epithecal covering; a specimen from South-west Point, Anticosti, has a breadth of about 8 inches with a thickness of nearly 2 inches at the centre. Other specimens, some of them from Manitoulin Island and vicinity, depart from this form of growth and have a less symmetrical shape; they are frequently much thicker without a cor-

responding increase in breadth. The corallites are compressed and diverge from one or more basal points outward with calyces oblique to the upper surface; they are thin walled throughout their length and vary in breadth from .5 to 1 mm., with a height of about .25 mm. Pores of moderate size placed at the angular edges of the corallites. Tabule numerous, directly transverse, about .5 mm. apart. In some of the Lake Huron specimens a longitudinal ridge is present on the lower side of the calyces, and two or three rows of septal spines can be seen projecting from the inner surface of the upper wall of the corallites.

Of this species Milne-Edwards and Haime remark that it very closely resembles *A. suborbicularis*, Lamarck, of the Devonian formation, a species that has not as yet been recognized in Canada.

ALVEOLITES NIAGARENSIS,* Rominger.

Alveolites Niagarensis, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 39, pl. XVI., figs. 1 and 2, but not *A. Niagarensis*, Nicholson, 1875.

"Convex hemispherical masses of concentrically laminated structure, covered by an epithecal crust on the lower concave side, or undose, discoid expansions composed of superimposed layers of prostrate tubes, diverging with a slight spiral twist from a central vertex, several of which are sometimes observed on an expansion. The compressed tubes are always more convex on the upper sides, with a corresponding concavity of the lower sides, which rest on the convexities of the subjacent tubes. The compression is sometimes only moderate, and the outside of the oblique orifices is formed by a projecting arched lip; in other specimens the compression is stronger, the orifices become narrow, lanceolate, or fissure-like, with an appressed subplane lip on the outer side. The orifices of the majority of specimens are surrounded by a cycle of denticules, corresponding to longitudinal rows of spinules along the inner surface of the tube walls. The rows are rarely fully twelve in number, and some of them are always more strongly developed than others. In some specimens no denticulation of the orifices can be observed, and the tube channels are found to be almost smooth; this is not the case in all cases owing to the want of development of the crests or spinules; these seem often to have been obliterated by imperfect preservation in the process of petrification."

* In 1839 Mr. S. A. Miller in his "North American Geology and Palæontology" proposed the name *A. undosus* for this species. As Nicholson had already, in 1875, in the "Palæontology of Ontario" described a dendroid coral from the Niagara limestone at Rockwood, Ont., under the name *Alveolites Niagarensis*, and as this coral is not an *Alveolites* but most probably a *Cladopora*, the specific name of Rominger's coral is here retained.

allites are compressed and outward with calyces oblique to throughout their length and vary of about .25 mm. Pores of the corallites. Tabulae apart. In some of the Lake sent on the lower side of the es can be seen projecting from allites.

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r. Mich., Foss. Corals, p. 39, pl. *Niagarensis*, Nicholson, 1875.

trically laminated structure, lower concave side, or of superimposed layers of spiral twist from a central rved on an expansion. The the upper sides, with a corresrest on the convexities of the imes only moderate, and the projecting arched lip; in other ifices become narrow, lanceo-e lip on the outer side. The und by a cycle of denticules, es along the inner surface of ewelve in number, and some of n others. In some specimens red, and the tube channels are ase in all cases owing to the s; these seem often to have n the process of petrification."

ican Geology and Paleontology" Nicholson had already, in 1875, in the al from the Niagara limestone at *rensis*, and as this coral is not an ic name of Rominger's coral is here

"Diaphragms somewhat distant and oblique. Pores large, marginal, causing a pouch-like dilation of the tube wall at the spot where situated. Diameter of tubes in the wider transverse direction varies in different specimens, from a half to one millimeter, which difference in size greatly alters their aspect. The degree of compression of the tubes, their more erect or more prostrate position in various specimens also cause numerous variations in their appearance, but no tangible line between one and another of the forms exists." "It occurs in great abundance in the Niagara group of Drummond Island, at Point Detour, and in other localities." (Rominger.)

With this species are identified specimens collected by R. Bell, at the north end of Lake Temiscaming, Que., in 1887, by J. B. Tyrrell, in 1890, at Grand Rapids, Roche Rouge, Cross Lake Rapids and Chemahawin, all on the Saskatchewan River, in the district of Saskatchewan, by D. B. Dowling, at Grand Rapids, in 1881, and by A. E. Barlow, on the Isle of Mann (Burnt Island) Lake Temiscaming, Que., in 1893. At these localities the rocks are of Niagara age. The large prominent pores mentioned by Rominger are well shown, especially in the specimens from Cross Lake Rapids, where the rock is a light yellow dolomitic limestone, and the coral is preserved so that the corallites are free of matrix and show the tabulae and septal spines; in the examples from Lake Temiscaming the structure is best seen in sections. Another specimen was collected at Limestone Rapids, on the Fawn branch of the Severn River, by A. P. Low, in 1886.*

The corallites in these particular specimens are irregularly polygonal, scarcely any compression is noticeable and they emerge rather at right angles than obliquely to the surface. A near approach to *Favosites* is thus seen to occur in a species which shows a considerable variation in structural details on which depend its generic affinities.

ALVEOLITES GOLDFUSSI, Billings.

- Alveolites Goldfussi*, Billings. 1860. Canadian Journal, new series, vol. V., p. 255, fig. 5.
 " " Nicholson. 1874. Palæon. of Ont., p. 56.
 " " Rominger. 1876. Geol. Sur., Mich., p. 42, pl. XVII., fig. 2.
 " " Hall. 1876. Illus. Dev. Foss., pl. XIV., figs. 5-9.
 " " Whiteaves. 1889. Contr. to Can. Palæon., vol. I., pt. II., p. 121.

Corallum forming discoidal masses with an undose upper surface; attached by the centre of the basal surface, which is approximately horizontal, uneven and covered by a thin, minutely and concentrically striated epitheca; sometimes measuring as much as 9 inches across, with

See foot-note p. 4.

a thickness of 2 or 3 inches. The corallites, as seen in vertical sections radiate upward and outward from the basal nucleus with a spiral twist and emerge obliquely to the surface; they are thin walled throughout their length, subpolygonal in transverse section, about 1.5 mm. wide and .9 mm. high, generally with a broadly arched convex upper wall, one or two somewhat concave lower walls and two short, straight, side walls, with modifications of these. The obliquity of the corallites to the surface and their compression are subject to much variation, those that are most oblique showing the greatest amount of compression. The corallites undergo no change at the surface, they end abruptly without expanding and without any thickening of their walls, the calyces being subpolygonal and of the same shape and size as the corallites in the interior of the corallum. Mural pores of moderate size, occurring in the sides of the walls of the corallites, not numerous. Tabulae complete, placed at irregular intervals. The inside surfaces of the walls of the corallites, as shown by natural exposure through weathering and by means of sections, are studded with numerous small squamulae arranged in longitudinal rows, those of one row alternating with those of the next, in the manner so usual in certain species of Devonian *Favosites*. On the basal surface of the corallum the thinness of the epitheca permits of the shape of the corallites, which here radiate outward almost horizontally from the centre, being clearly seen.

Of not infrequent occurrence in the Hamilton formation of Ontario, and also found in the Corniferous limestone, as is evinced by a specimen in the collection from Cayuga, Ont., collected by J. DeCew.

ALVEOLITES SQUAMOSA, Billings.

Alveolites squamosus, Billings. 1860. Canadian Journal, new series, vol. V., p. 257.
 " " Rominger. 1876. Geol. Sur. Mich., p. 41, pl. XVI, figs. 3 and 4.

Corallum in the form of irregularly shaped expansions, attached by the centre of the base, sometimes 5 or 6 inches in diameter and about 1 inch thick. Often a much greater thickness is attained by the growth of additional layers of coral, one above the other. Upper surface irregular, generally more or less convex, lower surface flat, protected by a thin, somewhat concentrically wrinkled epitheca, in which the lateral outlines of the corallites radiating outward can be seen. Corallites thin walled, compressed, very oblique to the surface, from .5 to 1 mm. broad and about .25 mm. high; in transverse section they are broadly arched above, and concave on either side of the centre below. The interior of the corallites is studded with numerous sharply pointed

seen in vertical sections nucleus with a spiral twist the thin walled throughout, about 1.5 mm. wide and convex upper wall, one or short, straight, side walls, of the corallites to the much variation, those that of compression. The corallites abruptly without expansion, calyces being subpolygonal in the interior of the wall in the sides of the walls complete, placed at irregular in the corallites, as shown by sections, are studded with longitudinal rows, those of the manner so usual in the surface of the corallum of the corallites, which the centre, being clearly

on formation of Ontario, as evinced by a specimen J. DeCew.

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new series, vol. V., p. 257. h., p. 41, pl. XVI., figs.

expansions, attached by ches in diameter and ness is attained by the above the other. Upper lower surface flat, pro- kled epitheca, in which outward can be seen. to the surface, from 5 nsverse section they are de of the centre below. merous sharply pointed

septa spines, and near the calyces a longitudinal ridge is present on the lower wall, whilst in some specimens indications of two longitudinal ridges can be seen occupying the inner surface of the upper wall. Pores numerous and placed at the angular sides of the corallites. Tabulæ complete.

Found in the Corniferous limestone of Ontario.

ALVEOLITES VALLORUM, Meek.

- ? *Alveolites suborbicularis*, Lamarck. 1816. Hist. des An. sans. vert., vol. II., p. 186.
? *Calamopora spongites*, var. *tuberosa*, Goldfuss. 1829. Petrefacta Germaniæ, p. 80, pl. XXVIII, figs. 1a-e (cont. exclusis).
Alveolites vallorum, Meek. 1868. Trans. Chicago Acad. of Sciences. vol. I., p. 86, pl. XI., figs. 9, 9a.
? *Alveolites suborbicularis*, Nicholson. 1879. Paleoz. Tab. Corals, p. 126, pl. VI., figs. 2, 2a-b.
Alveolites vallorum, Whiteaves. 1891. Contr. to Can. Paleon., vol. I., pt. III., p. 207; and 1892, ibid, vol. I., pt. IV., p. 274.

Corallum forming irregular expansions of considerable thickness with a small basal attachment, upper surface generally uneven of variable shape, under surface provided with an epithecal covering, somewhat flat, at times showing rough concentric wrinkles marking successive stages of growth, reaching a breadth of 5 or 6 inches with a thickness of about $1\frac{1}{2}$ inch. Corallites moderately thin walled throughout their length, flattened, wider than high, with a broadly arched upper wall and generally doubly concave on the lower side, reaching the surface at a somewhat oblique, but rather variable angle; average size .75 mm. wide and .5 mm. high. Pores of fair size, about .2 mm. in diameter and .5 mm. apart, occurring in single rows near the two angular sides of the corallites. Tabulæ numerous, complete, from about eight to fourteen in a space of 5 mm. Numerous small spiniform septa project from the inner surfaces of the walls of the corallites; these are only seen in very well preserved specimens, either in polished sections or when the corallites are free from matrix. A strong longitudinal ridge is present on the lower surface of the calyces and extends apparently for a short distance only into the interior of the corallites. At times the corallites appear to radiate from a number of centres, with a consequent result that the corallites in these specimens are rather unequal in size, and their obliquity to the surface is variable.

This species was described by Meek from specimens collected by Robert Kennicott at the "Ramparts" on the Mackenzie River, forty miles above old Fort Good Hope. Through the kindness of the authorities of the Smithsonian Institution, Washington, the writer has been

enabled to examine Meek's type specimens and to compare them with specimens in the Survey collection, from the Hay, Mackenzie, Peace and Moose rivers, and Lake Winnipegosis, that had been referred by Mr. Whiteaves to Meek's species.

Alveolites vallorum bears a striking resemblance to *A. suborbicularis*, Lamarck, as figured by Goldfuss in the *Petrefacta Germaniæ*, pl. XXVIII, figs. 1a—c. The resemblance in structural details between the two species is also seen in a description given by Nicholson of some specimens of *A. suborbicularis* collected by him in the Eifel; this authority is inclined to separate a form with numerous spiniform septa and a pedunculate base from one with an incrusting habit in which septa were not seen. From Goldfuss's figures it would appear that the corallum is very variable in shape and would include both forms. As regards the septa, they can be recognized only under favourable circumstances in well preserved specimens. The retention of Meek's species for the reception of the Canadian specimens is, however, thought advisable until it can be ascertained by direct comparison what the true relationship of *A. vallorum* to *A. suborbicularis* really is.

This species is represented in the collection by specimens from Devonian rocks at the following localities: junction of the Red and Peace rivers, A. R. C. Selwyn and J. Macoun, 1875; between the Long Portage of the Missinaibi branch of the Moose River and Moose Factory, R. Bell, 1877; Hay River, forty miles above its mouth, R. G. McConnell, 1887 and 1888; Mackenzie River at the "Ramparts" and at "Rock by the river's side," R. G. McConnell, 1888; Peace River at Vermilion Falls, R. G. McConnell, 1889; Lake Winnipegosis, J. B. Tyrrell, 1889, on the Red Deer River, at several localities in Dawson Bay, on Manitou Island, on a small island off Weston Point, and on Snake Island.

Genus *CÆNITES*, Eichwald. 1829.

(Zool. Spec. t. I., p. 179.)

Limaria, Steiningcr. 1831. Mem. Soc. Géol. de France, t. I., p. 330.

Corallum dendroid or forming thin expansions with a basal epitheca, composed of flattened or subpolygonal corallites that reach the surface by an abrupt bend and terminate in narrow slit-like calyces almost at right angles to the surface; walls of the corallites thin except at the surface where they are suddenly thickened; mural pores irregularly dispersed; tabule complete, transverse, rather distant; three longitudinal ridges are sometimes present in the outer ends of the corallites.

and to compare them with Hay, Mackenzie, Peace and had been referred by Mr.

blance to *A. suborbicularis*, Petrefacta Germania; pl. structural details between given by Nicholson of some in the Eifel; this author- ous spiniform septa and a habit in which septa were appear that the corallum is both forms. As regards the variable circumstances in well species for the reception t advisable until it can be relationship of *A. vallosum*

tion by specimens from : junction of the Red acoun, 1875; between the Moose River and Moose es above its mouth, R. G. at the "Ramparts" and at l, 1888; Peace River at lake Winnipegosis, J. B. eral localities in Dawson ff Weston Point, and on

1829.

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t. I., p. 339.

ons with a basal epitheca, that reach the surface by e calyces almost at right in except at the surface es irregularly dispersed; e longitudinal ridges are ites.

Cenites appears to be most nearly related to *Cladopora*, from which it is distinguished by the shape of the calyces and by the sudden, not gradual, thickening of the walls of the corallites at the surface. The corallites are at first prostrate, when the corallum has the form of a thin expansion, but when it is dendroid they are almost upright in the centre of the branch or stem. The calyces are transversely elongated and may be straight or curved.

CENITES JUNIPERINA, Eichwald.

- Cenites juniperinus*, Eichwald. 1829. Zoolog. speciale, t. I., p. 197.
Limaria clathrata, Lonsdale. 1839. Murch. Sil. Sys., p. 692, pl. 16 bis, figs. 7, 7a, 7 b.
Cenites juniperinus, Milne-Edwards and Haime. 1851. Polyp. Foss. des Terr. Palæoz., p. 301.
Limaria ramulosa, Hall. 1852. Palæon. New York, vol. II., p. 142, pl. XXXIX., figs. 4a—d.
Cenites juniperinus, Milne-Edwards and Haime. 1855. Brit. Foss. Corals, p. 276, pl. LXV., figs. 4, 4a.
Alveolites repens, Billings. 1863. Rep. of Progress, Geol. Survey of Canada, p. 323.
Alveolites Niagarensis, Nicholson and Hinde. 1874. Canadian Journal, new series, vol. XIV., p. 152 and 1875, Palæon. of Ont., p. 56, fig. 27.
Limaria ramulosa, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 43.
Cenites juniperinus, Nicholson. 1879. Palæoz. Tab. Corals, p. 134, pl. VI., figs. 5, 5 b.

"Corallum dendroid, of cylindrical dichotomously-dividing branches, the diameter of which is generally about two lines. Corallites nearly vertical in the centre of the branches, with thin walls, and about one-sixth of a line in diameter; gradually diverging in their upward course till they reach a point from one-quarter to half a line from the surface, when they suddenly bend outwards, their walls being now greatly thickened, and the visceral chamber reduced to a mere slit. Calices fissure-like and elongated in the direction of the transverse diameter of the branches, their long diameter about one-third of a line; the lower margin adorned with two prominent teeth, while the upper margin carries a single tooth corresponding in position to the notch between the lower teeth. Tabule not very numerous, but well developed and complete. Mural pores moderately numerous, circular, not excessively large, irregularly distributed." (Nicholson.)

A number of fragments, from 1 to 2 inches long, of a dendroid coral with cylindrical branches, about 4 mm. thick, from the Niagara formation at Thorold, Ont., are referred to this species. In longitudinal sections the structure is seen to be similar to that described by Nicholson; the thickening of the walls of the corallites when they bend abruptly outward near the surface, and the mural pores and tabule are clearly seen. Transverse sections show that a prominent longitudinal ridge occupies the

inner sides of the corallites near the surface, and in one corallite this ridge is opposite to two ridges in the outer wall.

Niagara formation.—Thorold, Ont., collected by E. Billings.

CENITES LUNATA, Nicholson and Hinde.

Cenites lunata, Nicholson and Hinde. 1873. Canadian Journal, new series, vol. XIV., p. 151, figs. 2a, b, c.

" " Nicholson. 1875. Palæon. of Ont., p. 55, figs. 25a, b, c.

"Corallum forming a thin crust, apparently about two-thirds of a line in thickness. Calyces strongly curved, crescentic or lunate, their form being due to the projection into their cavity of a single strong rounded tooth developed from the concave lip. Calyces about one-fourth of a line in their long diameter, and one-eighth of a line across; eight in the space of two lines. Corallites perpendicular to the surface, appearing as if embedded in a dense cunenchyma, though this is most probably due simply to the great thickening of their walls." (Nicholson and Hinde.)

Niagara formation.—Owen Sound, Ont., J. Townsend, 1874; north end of Lake Temiscaming, Que., R. Bell, 1887; and the "Jumpers" Anticosti.

CENITES SELWYNII, Nicholson. (Sp.)

(Plate I., figs. 4, 4a.)

Alveolites Selwynii, Nicholson. 1874. Geological Magazine, new series, vol. I., p. 15, fig. 3; 1874, Palæon. of Ont., p. 56, fig. 15, plate VII., fig. 4.

Corallum in the form of a thinly incrusting expansion about 2 mm. thick with a thin basal epitheca. Corallites flattened throughout their length, prostrate and by a sudden upward bend debouching at right angles, or with only a slight obliquity to the surface; average breadth slightly over 1 mm., average height .25 mm. Walls of the corallites thin, except at the surface, where they are greatly thickened, causing the calyces to have the form of narrow slits. Calyces more or less curved, sometimes straight, about 2 mm. long and .25 mm. wide with thick rounded margins and a broad not very distinct lip on the concave side of the opening; a depressed line surrounding the calyces defines the outer limits of the corallites. Tabulæ complete, distant. Mural pores of medium size, placed about 1 mm. apart in the narrow edges, but also occurring irregularly in the broad sides of the corallites. The epitheca is finely striated in a direction at right angles to the length of the corallites. The calyces are sometimes quite straight, but it is usual to find them either evenly curved backward or else bending backward at either end; they are about 1 mm. in advance of each other and overlap laterally.

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... Journal, new series, vol. XIV.,

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Canites Selwynii bears a close resemblance to the Silurian *C. linearis*, Milne-Edwards and Haime*, but its calyces are about twice as broad and are more generally curved than straight.

Rare in the Corniferous limestone of Ontario: the specimen described by Nicholson, the only one that he had seen, was collected at Port Lamborne; the single specimen representing the species in the collection of the Geological Survey was obtained by Mr. S. W. Howard, at Hagersville, Ont., and presented to the museum in 1890.

GENUS CLADOPORA, Hall. 1852.

(Palæon. New York, vol. II., p. 137.)

Corallum ramose, sometimes reticulated, flabellate or palmate, or forming laminar expansions, composed of closely united, subpolygonal corallites with expanded calyces that are oblique to the surface and margined below by a lip; walls of the corallites at first thin but becoming gradually thicker as the surface is approached; pores not numerous, dispersed; tabulae complete, transverse; three denticulated ridges developed near the calyces; squamulae sometimes present; opercula closing the calyces present in some species; epitheca rarely developed.

This genus is distinguished from *Favosites* and *Alveolites* principally by the gradual thickening of the walls of the corallites near the surface, and by the expansion of the calyces, which are bordered below by a more or less prominent lip. The corallites are at first subpolygonal and sometimes slightly compressed, later becoming more nearly circular as the walls thicken; in the ramose or fan-shaped forms they diverge from an inner axial line or plane and end in circular, oval, reniform, sometimes almost lunate calyces more or less oblique to the surface. The longitudinal ridges apparently do not extend far into the corallites and end where the calycular expansion takes place. The walls of the corallites are distinct and do not completely coalesce.

CLADOPORA MULTIPORA, Hall.

Cladopora multipora, Hall. 1852. Palæon. New York, vol. II., p. 145, pl. XXXIX. figs. 1 a—g.

Favosites? multipora, Nicholson. 1875. Palæon. of Ontario, p. 53.

"Frond ramose or reticulate; branches short, terete, in the reticulations cylindrical; cells numerous, closely arranged, penetrating to the axis in a slightly oblique direction; openings upon the surface subangular or circular, sometimes apparently transverse; reticulations irregu-

lar, and the dichotomous branches often extending beyond and terminating in terete forms. Cells 48 or 60 in the space of an inch longitudinally." (Hall).

This species is represented in the survey collection by specimens from Lake Temiscaming, Que., collected by Sir William Logan, in 1845, and Dr. Robert Bell, in 1887.

From an examination of the Canadian specimens it is seen that the corallum is formed of a number of upright stems, with an average diameter of 3.5 mm., growing closely together in an irregular manner and frequently branching and anastomosing so as to form an obscurely reticulated mass. The corallites are almost vertical, or only slightly inclined outward in the central part of the stems or branches, but near their distal ends they bend rather abruptly outward so that the calyces are almost at right angles to the surface. The walls of the corallites become stouter as they approach the surface, where the maximum thickness is attained. The calyces are rather irregularly disposed, not arranged in definite rows, somewhat angular, wider than high, their distance apart vertically being about equal to their width; from .3 to .5 mm. wide and about half as high. Tabulæ and septa have not been recognized, but comparatively large mural pores are seen to be present.

Milne-Edwards and Haime, in their *British Fossil Corals*, p. 263, make *Cladopora multipora*, Hall synonymous with their species *Alveolites ? seriatoporoides*. This opinion, the writer is not fully prepared to follow, and prefers, for the present at least, to refer the Canadian specimens to Hall's species.

Locality.—Lake Temiscaming, Que.; Niagara formation.

CLADOPORA CRASSA, Rominger. (Sp.)

Limaria crassa, Rominger. 1878. Geol. Sur. Mich., Foss. Corals, p. 44, pl. XVIII, fig. 1.

Coral thinly incrusting, from 2 to 4 mm. thick, but at times apparently thicker, due to the growth of one layer over the other, composed of thin walled and sometimes slightly compressed, prostrate corallites that bend upward to the surface with thickened walls and end in moderately oblique, transversely subelliptical calyces with a not very prominent lip on the upper edge. Calyces about .75 mm. in width and slightly less from back to front, and separated from each other by an average distance, due to the thickened walls at the surface, of .5 mm. Sometimes by the growth of a layer on the basal surface of another, a comparatively thick expansion is formed having calyces opening on either

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sides. Mural pores of average size, irregularly dispersed. Tabulae com-
plete, apparently numerous. Rominger mentions the presence in his
specimens*, in the interior of the corallites, of three "crests" such as are
found in *Cladopora cryptodens*, Billings, one on the inner side of the wall
near the mouth, the other two opposite on the outer wall. The epitheca
covering the lower surface and mentioned by Rominger in his description
of the species is not preserved in the Canadian specimens.

This species is very like the Devonian form *Cladopora turgida*, Rominger in general appearance and structure, and apparently differs only from it in its less robust growth and in its usually incrusting habit.

Niagara formation.—North end of Lake Temiscaming, Que., R. Bell, 1887; Isle of Mann (Burnt Island) Lake Temiscaming, A. E. Barlow, 1893.

CLADOPORA CRYPTODENS, Billings. (Sp.)

(Plate I., figs. 5, 5a.)

Alveolites cryptodens, Billings. 1859. Canadian Journal, new series, vol. IV., p. 115, fig. 10.

Favosites polymorpha (pars), Billings. 1859. Ibid, p. 111, fig. 11.

Striatopora formosa, Billings. 1860. Canadian Journal, new series, vol. V., p. 254.

Cladopora magna, Hall and Whitfield. 1873. Twenty-third Report, N.Y. State Museum of Nat. Hist., p. 230, pl. 10, figs. 3 and 4.

Cladopora cryptodens, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 49, pl. XX., figs. 1 and 2.

Pachypora or *Alveolites* (cf. *A. cryptodens*, Bill.), Whiteaves. 1892. Contr. to Can. Paleon., vol. I., pt. IV., p. 273.

Corallum ramose, rather straggling in its growth, consisting of slender stems, circular in transverse section, sometimes as much as 15 mm. in diameter, that branch or bifurcate at rather distant intervals. Corallites radiating upward and outward, and issuing obliquely to the surface in slightly expanded somewhat circular calyces margined below by a sharp prominent well defined lip. Walls of the corallites moderately thin at first, but becoming thicker as the surface is approached, where the maximum thickness is attained. Corallites circular or rounded polygonal in section, gradually increasing in size until an average diameter of 1.5 mm. is attained at the surface. Tabulae, as seen in longitudinal section, complete, about .5 mm. apart. Squamulae small, occurring on the sides of the walls of the corallites. Pores rather irregular in distribution, of moderate size. Three longitudinal ridges are present in the interior of the corallites; beginning near the mouth they appear to extend a short distance inward and are apparently denticulated at the edge; one of these

* From the Niagara limestone of Point Detour, Drummond Island, Lake Huron, &c.

ridges occupies the side nearest the axis of the stem or branch and is opposed by the remaining two on the side toward the exterior.

A certain amount of variation is noticeable in different specimens, and in parts of the same specimen, in the obliquity of the calyces to the surface; in the lower parts of the corallum especially, the corallites are apt to emerge more nearly at right angles to the surface. That this species is at times reticulated, is borne out by a specimen presumably belonging to this species, in which frequent coalescence of the branches is observable. In some specimens many of the calyces are closed by opercula.

In only a few of the specimens are the longitudinal ridges apparent, the corallites being as a rule either filled with matrix or quite empty with smooth sides. The tabulae and squamulae are seen in longitudinal sections, whilst the pores are preserved in most of the specimens. The wearing or weathering of the surface, with the destruction of the lips of the calyces, brings to light the subcircular or polygonal outlines of the individual corallites, a feature not seen when the surface is entire.

In a specimen of *C. cryptodens*, in which the tooth-like ridges are preserved near the mouths of the corallites, striations are seen on the walls of the calyces, as in *Striatopora formosa*. These two species are strikingly similar in outward form and the discovery in the former of a character which was relied on for their specific as well as generic separation, can scarcely leave any doubt as to their being conspecific. The calicular striations are not seen except in weathered specimens and may represent septal ridges or grooves only partially developed, or possibly are the result of the unequal weathering of the wall substance of the corallites. The specimen of *C. cryptodens* referred to was obtained in the Corniferous limestone at Rama's Farm, Port Colborne, Ont., by E. Billings in 1857.

This species occurs in the Corniferous limestone of Ontario and in the Devonian formation on the Red Deer River, Lake Winnipegosis; it has also been collected from Devonian rocks at the Long Portage, Missinaibi River, and on the Albany River.

CLADOPORA LABIOSA, Billings. (Sp.)

- Alveolites labiosa*, Billings. 1859. Canadian Journal, new series, vol. IV., p. 104, figs. 14 and 15.
Cladopora prokistea, Hall and Whitfield. 1873. Twenty-third Report N.Y. State Museum of Nat. Hist., p. 230, pl. 10, fig. 2.
Alveolites labiosa, Nicholson. 1874. Paleon. of Ont., p. 53, fig. 12.
Alveolites Billingsi, Nicholson. 1874. Ibid. p. 55, fig. 14c.
Cladopora labiosa, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 51, pl. XXI, fig. 2.

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LABS.]

Corallum ramose, reticulate or subpalmate; branches or subdivisions circular or oval in transverse section, varying in thickness from 3 to about 8 mm.; calyces oblique to the surface, slightly expanded, with the outer edge produced into a strong projecting lip, subcircular sometimes slightly broader than high, from about .3 to .5 mm. across; when the surface is abraded the openings appear triangular and higher than broad owing to the loss of the lip. The calyces are sometimes about their own diameter apart, often closer. Corallites rounded polygonal or subcircular, their walls thickening gradually toward their distal ends. Mural pores small, few in number, irregularly placed. What appear to be tabulae have been observed in some specimens. Rominger mentions (op. cit.) having seen longitudinal ridges in the interior of the corallites of this species, as in *Cladopora cryptodens*, Billings, but they have not been detected in the specimens that have come under the writer's notice.

This species differs from *Cladopora cryptodens*, Billings, to which it is most nearly allied, principally in the more slender form of the corallum and in its more delicate structure.

Occurs in the Corniferous limestone of Ontario; a loose specimen was collected by R. Bell, in 1886, on the Albany River which flows in the latter part of its course through a large Devonian area.

CLADOPORA FISCHERI, Billings. (Sp.)

Alveolites Fischeri, Billings. 1860. Canadian Journal, new series, vol. V., p. 256, fig. 6.

" " Nicholson. 1874. Palæon. of Ont., p. 57.

Cladopora Fischeri, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 47, pl. XIX, figs. 1 and 4.

Pachypora Fischeri, Nicholson and Etheridge, jun. 1877. Jour. Linn. Soc., vol. XIII, p. 362, pl. XX, figs. 18-20.

" " Nicholson. 1879. Palæoz. Tab. Corals, p. 91, fig. 16.

" " Whiteaves. 1889. Contr. to Can. Palæon., vol. I., pt. II., p. 121.

Corallum in the form of irregularly palmate or flabellate, thin expansions, arising from a short, stout, stalk-like base and attaining to a considerable size: sometimes as much as 4 inches high, seldom more than 6 mm. thick and at times expanding above to a breadth of about 3 inches. Corallites irregularly polygonal, having an average diameter of about .5 mm. but varying considerably in size, with moderately thin walls that exhibit a gradual thickening toward the calyces. The corallites bend outward and upward, as in other species of this genus having a palmate or flabellate corallum, from a central axial plane and issue obliquely to the surface on both sides of the expansion. Calyces, with an average breadth of about .75 mm., circular, transversely oval, semicircular or reniform, with the lower edge produced so as to form a sharp-edged lip;

distance apart variable, depending on the amount of thickening of the walls of the corallites at the surface, but generally less than their width. In parts of the corallum, possibly where the regularity of growth has been disturbed, the calyces are nearly or quite at right angles to the surface and irregular in shape, with rounded outlines and without a lip. Often on one side of the expansion, as in *Cladopora turgida*, Rominger, the outlines of the calyces are less sharply defined and more depressed than on the other, the difference in the two sides resulting possibly from the corallum not growing quite erect, the side on which the more sharply defined calyces are being probably uppermost. The calyces are frequently closed by opercula. Mural pores of moderate size, about 1 mm. apart vertically, and not occurring in regular rows. Tabulæ complete, few in number.

This species is apparently nearly related to *Cladopora turgida*, Rominger, from which it can be readily distinguished by the comparative thinness of its corallum and more delicate form of growth generally, and by the smaller size of its calyces, which have thinner walls and are consequently much closer together.

Abundant in the Hamilton formation of Ontario, and found occasionally in the Corniferous limestone of the same province.

CLADOPORA FRONDOSA, Nicholson. (Sp.)

Alveolites frondosa, Nicholson. 1874. Geological Magazine, new series, vol. I., p. 15, pl. II., fig. 2; 1874. Paleon. of Ont., p. 57, fig. 16.

Cladopora Canadensis, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 46, pl. XIX., fig. 3.

Pachypora frondosa, Nicholson and Etheridge, jun., 1877. Jour. Linn. Soc., vol. XIII., p. 362.

" " Nicholson. 1879. Palæoz. Tab. Corals, p. 94, fig. 17.

" " Whiteaves. 1889. Contr. to Can. Palæon., vol. I., pt. II., p. 121.

Corallum irregularly palmate with a stout massive base, spreading above into a thin lobate expansion; three or four or probably more inches in height, somewhat less in breadth, from 1 to about 5 mm. thick in the upper portion, and sometimes attaining a diameter of as much as 23 mm. near the base. Corallites subpolygonal or circular, .3 mm. in average diameter, beginning with moderately thin walls that become gradually thickened as they proceed outward from the central axial plane to the surface on both sides, where their greatest thickness, which is often considerable, especially in the basal portion of the corallum, is reached. Calyces small, lunate or crescentic, about .6 or .7 mm. in breadth, provided below with a sharp lip that is more or less prominent and often depressed below the general level; generally about their own breadth apart, or even

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Corals, p. 94, fig. 17.

Paleon., vol. I., pt. II., p. 121.

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less, but often more widely separated, especially near the base. Lips of
the calyces more or less indented at the centre. As in *C. Fischeri*,
Billings, and *C. turgida*, Rominger, the outlines of the calyces are more
rounded off or less sharply defined on one side of the corallum than on the
other, and on this side also faint polygons, surrounding the calyces, are
sometimes seen marking the limits of contiguous corallites at the surface.

Abundant in the Hamilton formation of Ontario. Mural pores rather
small, few in number. Tabulae not observed, but they are mentioned by
Nicholson as being present in specimens examined by him.

This species is distinguished from *C. Fischeri* mainly by the smaller
size of the corallites and the decidedly crescentic shape of the calyces; it
appears to form a link connecting this genus with *Ctenites*, Eichwald, in
which the walls of the corallites are very much thickened at the surface,
and the calyces have the form of curved or linear fissures.

CLADOPORA TURGIDA, Rominger.

Cladopora turgida, Rominger. 1876. Geol. Surv. Mich., Foss. Corals, p. 48, pl.
XIX., fig. 2.

Corallum in the form of flabellate expansions with rounded edges,
attaining a height of over 5 inches with a thickness of about 10 mm.,
and of varying breadth. Corallites diverging upward and outward from
an imaginary inner axial plane, which is often nearer one side of the
expansion than the other, and issuing obliquely to the surface on both
sides and on the edges of the corallum; calyces generally slightly over
1 mm. in maximum width, circular or transversely oval, with a slightly
thickened lip forming the lower boundary, and generally less than their
width apart. The corallites, owing to the excentricity of the axial plane
from which they ascend, are often longer on one side of the expansion
than on the other, the longer corallites having more prominent and less
oblique calyces than the shorter ones. Corallites almost circular and
greatly thickened as the surface is approached. Mural pores, distant,
rather small. What appear to be tabulae are seen in a few specimens at
distant intervals. The calyces, especially in the lower portions of the
corallum, are frequently closed by opercula.

Occurs in the Corniferous limestone of Ontario. A fragment of a
specimen of this species was collected by R. Kennicott at the "Ram-
parts," Mackenzie River, and is the property of the United States
National Museum at Washington.

CLADOPORA LICHENOIDES, Rominger.

Cladopora lichenoides, Rominger. 1876. Geol. Surv. Mich., Foss. Corals, p. 46, pl. XVII., figs. 1 and 4.

Corallum spreading horizontally in rather thin laminar expansions from 2 or 3 mm. to over 10 mm. in thickness, with an epitheca on the lower side; frequently the expansions occur one above the other in an approximately parallel sequence, one tier connected with the one immediately below it at one or more points, but otherwise distinct and separated by varying distances. Corallites averaging 1 mm. in diameter at first prostrate and as a rule slightly flattened, then bending upward and becoming more nearly circular in transverse section, and finally emerging at a slightly oblique angle to the surface. Walls of the corallites thin below, but gradually thickened as the surface is approached in some specimens considerably more than in others. Calyces rather variable in shape, irregularly subpolygonal or oval, 1 mm. in average width, three or four occurring in a space of 5 mm.; they are without a definite lip except when their obliquity to the surface becomes pronounced. Tabulae complete, distant. Squarulae, as shown in one specimen, occurring on the inside of the walls of the corallites. Mural pores of moderate size, not abundant.

This species in having corallites that are more or less flattened when prostrate near the base of the expansion shows a certain likeness to *Alveolites*, which, however, disappears when the walls of the corallites become thick; it is readily distinguished from other species of *Cladopora* by its general form of growth.

Found in the Corniferous limestone of Ontario.

CLADOPORA RÆMERI, Billings. (Sp.)

Alveolites Ræmeri, Billings. 1860. Canadian Journal, new series, vol. V., p. 255.

" " Nicholson. 1874. Palæon. of Ont., p. 54.

Cladopora Ræmeri, Rominger. 1876. Geol. Surv. Mich., Foss. Corals, p. 50, pl. XX, fig. 3.

Alveolites Ræmeri, Whiteaves. 1889. Contr. to Can. Palæon., vol. I., pt. II., p. 121.

" " (pars) Whiteaves. 1891. Contr. to Can. Palæon., vol. I., pt. III., p. 207 (specimen collected by R. G. McConnell).

This species was defined by Mr. Billings in the following short description—"Stems from two to three lines in diameter, usually cylindrical but sometimes sub-palmate, branching. Cells transversely oval, about half a line wide and one-fourth of a line in length; in general distant from each other from half a line to two-thirds of a line in the longitudinal direction of the stem, and half that distance in the transverse direction.

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v. Mich., Foss. Corals, p. 46, pl.

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The branches or stems are generally found in a fragmentary condition, in pieces an inch or two in length. An examination of the type and other specimens in the collection of the Geological Survey tends to show that the only difference between this species and *C. Fischeri*, Billings, is found in the shape of the corallum, which in the former is ramose with cylindrical or subpalmate branches, and in the latter irregularly palmate or flabellate.

What has already been said about the general structure of *C. Fischeri*, as regards the form and size of the corallites and calyces, the disposition of the mural pores and other details, applies equally to *C. Romeri*, the only differences being those incidental to the change in the form of the corallum. Although in the latter species the cylindrical stems become at times subpalmate, no specimens of either species have apparently been seen that would justify the opinion that the two forms passed the one into the other; in the meantime therefore the writer is inclined to regard *C. Romeri* as worthy of specific distinction.

Found in the Hamilton formation of Ontario, and recognized by Mr. Whiteaves in a specimen collected by R. G. McConnell, in 1875, from the upper Devonian of the Peace River, in the district of Athabasca.

Genus MICHELINIA, De Koninck. 1842.

(An. foss. des terr. Carb. de la Belgique, p. 29.)

Corallum in lenticular, hemispherical or subcylindrical masses, attached by the centre of the base and provided with an epitheca; corallites thin walled, in contact or contiguous only at intervals, polygonal when touching, circular when apart, unequal in size, often large, their inner surfaces longitudinally striated by numerous impressed lines with septal spines on the interspaces; mural pores irregularly distributed or in vertical rows, also, when the corallites are in contact only at intervals, in single or double horizontal rows; tabulæ convex or flat, with small secondary tabulæ or cysts.

MICHELINIA CONVEXA, d'Orbigny.

Michelinia convexa, d'Orbigny. 1850. Prodr. de Paléont., t. I. p. 107.

" " Milne-Edwards and Haime. 1851. Polyp. Foss. des Terr. Palæoz., p. 251, pl. 16, fig. 1.

" " Billings. 1859. Canadian Journal, new series, vol. IV., p. 112, fig. 13.

" " Nicholson, 1874. Palæon. of Ontario, p. 63.

" " Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 72, pl. XXVI., figs. 1 and 2.

Corallum when young of a disk-like form with a convex upper surface and almost flat below, becoming later of a more hemispherical shape and passing with age into a roughly upright cylindrical mass without much lateral expansion; attaining a height of 10 or 11 inches with a breadth of 4 or 5. The point of attachment of the corallum is at the centre of the base which is covered by a strong, concentrically wrinkled epitheca. Corallites large, polygonal, thin walled, attaining a diameter of 9 or 10 mm., with small ones interspaced among the large ones; in some specimens the average size of the mature corallites is much less. Tabulæ strongly convex, numerous, with many secondary tabulæ or cysts resting on the complete tabulæ, principally nearer the walls of the corallites than at the centre, the whole forming a vesiculose mass filling the interior of the corallites. The presence of the secondary tabulæ on the primary ones gives to the latter a peculiar blistered appearance when seen from above. In corallites of average size about forty parallel, longitudinal striæ occur on the inner surface of the walls, which are further decorated on the spaces between the striæ by numerous short blunt septal spines. Pores of rather unequal size, edged with a raised rim, generally irregularly distributed though sometimes becoming more numerous and forming regular vertical rows between the longitudinal striæ.

Occurs in the Corniferous limestone of Ontario at Port Colborne, Cayuga and near Woodstock.

MICHELINIA CLAPPII, Milne-Edwards and Haime. (Sp.)

- Chonostegites Clappi*, Milne-Edwards and Haime. 1851. Polyp. Foss. des Terr. Palæoz., p. 290, pl. XIV., figs. 4, 4a.
Michelinia intermittens, Billings. 1839. Canadian Journal, new series, vol. IV., p. 113.
Haimeophyllum ordinatum, Billings. 1859. Canadian Journal, new series, vol. IV., p. 139, fig. 29.
Michelinia Clappii, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 75, pl. XXVIII., figs. 3 and 4.

Corallum forming large, somewhat hemispherical or lenticular masses, broadly convex above and rather flat or convex below, with subparallel corallites diverging outward and upward from a central basal point; reaching a breadth of over 1 foot and sometimes about 8 inches high. The corallites are thin walled, constricted at varying intervals, polygonal when in contact, circular and separated by a space from each other where constricted. In some specimens the corallites are large, nearly 8 mm. in average diameter, and slightly but sharply contracted at intervals of from 1 to 4 mm., the average width of the corallites where constricted being a little over 5 mm.; as seen from above the corallites appear circular. In other specimens the corallites are smaller, averaging

with a convex upper surface more hemispherical shape and cylindrical mass without much or 11 inches with a breadth of corallum is at the centre of centrally wrinkled epitheca. Having a diameter of 9 or 10 large ones; in some specimens much less. Tabulæ strongly tubular or cysts resting on the of the corallites than at the lining the interior of the corallum on the primary ones gives when seen from above. In longitudinal striæ occur on other decorated on the spaces septal spines. Pores of rather irregularly distributed and forming regular vertical

Ontario at Port Colborne,

and Haime. (Sp.)

Polyp. Foss. des Terr. Palæoz.,

al, new series, vol. IV., p. 113.

Journal, new series, vol. IV., p.

Mich., Foss. Corals, p. 75, pl.

corical or lenticular masses, ex below, with subparallel in a central basal point; sometimes about 8 inches at varying intervals, ed by a space from each the corallites are large, y but sharply contracted th of the corallites where from above the corallites es are smaller, averaging

about 5 mm. in diameter when in contact, and the constrictions are much more pronounced and very variable in their distance apart, causing the corallites to appear as slender cylindrical tubes from 2 to 5 mm. in diameter, with abrupt thin horizontal expansions at intervals of from 1 to over 10 mm. apart; the spaces separating the cylindrical portions of the corallites are here seen to be frequently much wider than the diameter of the corallites themselves. Between these extremes intermediate gradations occur in the same or in different specimens. The expansions in some specimens occur somewhat in the same plane, forming a floor in which the polygonal outlines of the corallites are seen in juxtaposition. The interior of the corallites is obscurely marked by from about thirty to fifty longitudinal striæ. Pores unequal in size, sometimes over .5 mm. in diameter, generally in one or two horizontal rows, where the corallites are in contact. Septal spines represented by close set, longitudinal, often interrupted rows of stout sharply pointed tubercles, generally more clearly defined on the contracted parts of the corallites than elsewhere. Tabulæ numerous, and of the same nature as those of *M. convexa*. The exterior surface of the corallites is marked by fine encircling rings of growth and by longitudinal lines corresponding to the inner striations. In a part of one specimen in particular the corallites, which are elsewhere normal in structure, approach closely in structure those of *M. convexa* in that they are constricted only at rather lengthy intervals, leaving the corallites polygonal and in contact for some distance.

Occurs in the Corniferous limestone of Ontario, near Woodstock, and in the townships of Walpole and Cayuga.

MICHELINIA FAVOSITOIDEA, Billings. *em. (favosoides)*.

Michelinia favosoides, Billings. 1859. Canadian Journal, new series, vol. IV., p. 114.

Michelinia favositoidea, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 73, p. XXVII., fig. 4.

"Corallum forming large hemispheric or flattened masses; cells unequal in size, adult diameter about two lines and a half; diaphragms flat, horizontal, with small vesicular swellings, usually around the margins of the upper surface; septal striæ very obscure, six to eight on each plane side of the cells; pores very small, irregularly distributed, sometimes in rows of five or six across the cell, about one-sixth of a line distant from each other in some places, and sometimes absent in spaces of half a line in width." (Billings). In the type specimen small, stout, short septal spines occur in abundance on the inner surfaces of the walls of the corallites.

Found in the Corniferous limestone at Port Colborne, Ont.

Genus STRIATOPORA, Hall. 1852.

(Paleon. New York, vol. II., p. 156.)

Corallum dichotomously branching, made up of subpolygonal corallites that terminate at the surface in expanded, shallow, radially striated and slightly oblique, unequal calyces that join each other in sharply defined polygonal outlines; walls of the corallites at first thin but gradually thickening toward the surface; pores irregularly distributed; tabulae complete, distant.

STRIATOPORA FLEXUOSA, Hall.

Striatopora flexuosa, Hall. 1852. Paleon. New York, vol. II., p. 156, pl. XL. B, figs. 1a-c.

" " Nicholson. 1875. Paleon. of Ont., p. 55, fig. 26a.

" Coral composed of bifurcating or irregularly ramose stems; branches terete; cells large, angular below, and opening in a circular striated aperture; striae extending beyond the cell, particularly in an upward direction; cells arranged in an irregularly alternating series; calicles labellate or extended on the lower side, and uniting above in angular ridges separating the cells; apertures very unequal in size.

" This species is readily distinguished by the form and arrangement of its cells, which are of much larger proportionate size than any of the ramose corals of the group. The apertures are round, but open into an angular depression, which is limited on the lower side by the calicle, but extends upwards to unequal distances depending upon the arrangement of the cells. The striae which are visible in the circular cell extend beyond into its angular space, and are very distinct in well preserved specimens." (Hall.)

The specimens on which Professor Hall's description was based were collected in the shale of the Niagara formation at Lockport, N.Y.

In the museum of the Geological Survey is a specimen of this species, apparently identified by the late Mr. Billings, from the Niagara formation, Sydenham Road, county of Grey, Ont.; collected by R. Bell, in 1861.

The principal point of difference between *S. flexuosa* and *S. Linneana*, Billings, is that the calyces of the former are larger and not so crowded together as those of the latter.

STRIATOPORA LINNEANA, Billings.

Striatopora Linneana, Billings. 1860. Canadian Journal, new series, vol. V., p. 253, fig. 1.

" " Nicholson. 1874. Paleon. of Ont., p. 59.

Striatopora Linneana, Rominger. 1876. Geol. Sur., Mich., Foss. Corals, p. 59, pl. XXIII., figs. 5, 6.

Striatopora Linneana, Nicholson. 1879. Paleoz. Tab. Corals, p. 100, pl. V., figs. 2-2d.

Striatopora Linneana, Whiteaves. 1889. Contr. to Can. Paleon., vol. I., pt. II., p. 121.

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Paleon., vol. I., pt. II., p. 121.

LAMBE.]

Corallum dendroid, composed of stems, from 5 to over 10 mm. thick, that branch generally dichotomously, at varying intervals. Corallites subpolygonal, at first thin walled and nearly vertical in the centre of the stems, then, curving gracefully outward with gradually thickening walls, they emerge at the surface, inclined slightly upward, and expand into wide, shallow calyces which join each other in sharp, thin edged, polygonal outlines. About twelve, sharply defined, longitudinal grooves pass outward from the interior of the corallites over the faces of the calyces, at the bottom of which they are most clearly marked. Calyces unequal in size, with numerous small ones intercalated between the larger ones; width varying in the large ones from about 1.5 to slightly over 2 mm. Mural pores of moderate size, irregularly distributed, not very numerous, occurring in the faces of the expanded calyces as well as in the inner parts of the corallites. Tabulae complete, transverse, distant.

Devonian.—Hamilton formation; township of Bosanquet, county of Lambton, Ont., at Thedford (Widder) and Bartlett's Mills.

Genus TRACHYPORA, Milne-Edwards and Haime. 1851.

(Polyp. Foss. des Terr. Palæoz., p. 305.)

Corallum ramose, consisting of cylindrical stems composed of short corallites diverging from an imaginary central axis in an alternating manner and opening on the surface in generally four rows of oval, very slightly oblique, distant calyces; walls of corallites thickening rapidly; mural pores small; tabulae directly transverse, few in number; septa apparently obsolete; edges of calyces obscurely striated in a radial direction; surface between the calyces delicately sculptured by irregular, longitudinal, impressed lines.

TRACHYPORA ELEGANTULA, Billings.

Trachypora elegantula, Billings. 1860. Canadian Journal, new series, vol. V., p. 254, figs. 2, 3, 4.

Dendropora elegantula, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 63, pl. XXIII., fig. 2.

Trachypora elegantula, Hall. 1876. Illus. Dev. Foss., pl. XXXIII., figs. 1-8.

" " Nicholson. 1879. Palæoz. Tab. Corals, p. 108, pl. V., figs. 4-4c.

" " Whiteaves. 1880. Contr. to Can. Paleon., vol. I., pt. II., p. 121.

Corallum upright, ramose, with branches proceeding from the stems at somewhat obtuse angles, and also branching dichotomously; stems 5 mm. in thickness and under, circular in section, sometimes flattened on four sides so as to be almost square in section. Oval calyces, with slightly raised margins, open on the surface in four or five longitudinal rows; sometimes one or two calyces occur separately between the rows. The raised margin of the calyces is frequently not continued across their

upper ends, or is not as well defined there as at the sides and below. The calyces average 1.5 mm. in height or length and 1 mm. in width, those of a row being at a distance from each other about equal to their length, and the rows themselves are at varying distances apart proportionate to the thickness of the stems or branches. The size of the calyces is about the same in large as in small stems. The surface between the calyces is delicately sculptured longitudinally by interrupted, generally wavy striae.

In longitudinal sections, short, slightly curved corallites are seen to pass upward and outward from an imaginary axial line to the surface, the calyces pointing slightly upward. The corallites on opposite sides of the axial line are at the same height and alternate with those of the other rows; this alternation is seen in longitudinal sections and is continued in the arrangement of the calyces at the surface. In the centre of the stems the corallites are small, about .5 mm. or less in width, subpolygonal, with thin walls, which rapidly grow thicker toward the surface. After the walls become thick all trace of the boundaries of contiguous corallites, as far as can be learned by transverse and longitudinal sections, is lost; and no indications of them are seen on the surface. Mural pores, small, few in number, confined apparently to those parts of the corallites where the walls are not excessively thickened. Tabulae few in number, complete, directly transverse. It is noticed that when the stems are flattened on four sides the rows of calyces occur on the angles. No septa or striae are seen, in longitudinal or transverse sections, in the interior of the corallites, but near the edges of the calyces obscure striations are observed passing out over the raised margins in a radial direction.

Devonian.—Hamilton formation; not uncommon at Thedford, Ont.

Genus *CALAPCECIA*, Billings. 1865.

(*Canadian Naturalist*, new series, vol. II., p. 425.)

Corallum massive, composed of rather equal, polygonal, subpolygonal or circular corallites either in contact and polygonal or distant and circular; walls of corallites of moderate thickness, amalgamated when in juxtaposition; pores so numerous as to reduce the walls to a mere lattice-work, forming regular longitudinal and horizontal rows; spiniferous septal ridges about twenty in number, between the longitudinal rows of pores and passing out over the slightly exsert edges of the calyces; tabulae complete, horizontal, often with secondary tabulae; spaces between corallites crossed by irregular horizontal diaphragms.

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CANADIAN PALAEZOIC CORALS.

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CALAPGECIA CANADENSIS, Billings.

Plate I., figs. 6, 6a and 7.

- Calapgecia Canadensis*, Billings. 1865. Canadian Naturalist, new series, vol. II., p. 426.
Calapgecia Huronensis, Billings. 1865. Ibid, p. 426.
Calapgecia Anticostiensis, Billings. 1865. Ibid, p. 426; and 1866, Cat. Sil. Foss. of Anticosti, p. 32, figs. 15a, 15b.
Columnopora cribriformis, Nicholson. 1874. Geological Magazine, new series, vol. I., p. 253, figs. 1a—c.
" " Nicholson. 1875. Palmon. of Ont., p. 25; and 1875, Geol. Survey of Ohio, vol. II., pt. II., p. 187, pl. XXII., figs. 8, 8a, 8b.
Houghtonia Huronica, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 17, pl. III., figs. 3 and 4.
Columnopora cribriformis, Nicholson. 1879. Palmoz. Tab. Corals, p. 164, pl. VII., figs. 2, 2a—d.
" " Whiteaves, 1880. Rep. of Progress for 1878-79, Geol. Survey of Canada, p. 48 C.
" " Whiteaves, 1881. Rep. of Progress for 1879-80, Geol. Survey of Canada, p. 67 C.

Corallum forming hemispherical, subspherical or somewhat turbinate, at times irregularly rounded, masses of polygonal, subpolygonal or circular corallites diverging from a basal beginning or point of attachment; reaching a height of nearly 6 inches with a breadth of about 4 inches. Corallites usually nearly equal in size in the same specimen and varying in diameter in different specimens from 2 to 4 mm.; either in contact and polygonal, or circular and separated from each other by a space of varying width. In the same specimen circular and polygonal corallites with intermediate gradations, sometimes occur, or they may be all circular or all polygonal, the circular corallites being at times nearly their own diameter apart but more frequently about half that distance and often almost in contact. Walls of the corallites of moderate thickness, about .25 mm. through, apparently completely amalgamated when the walls are in contact, perforated by large pores placed close together and forming regular horizontal and longitudinal rows. Pores circular, oval or quadrangular and so numerous as to reduce the walls to a mere reticulation of upright bars and horizontal rings the former of which are generally somewhat the stronger of the two and appear in the inside of the corallites as longitudinal ridges. Spiniform septa stout at the base, sharply pointed, about .3 mm. long and inclined slightly upward, occurring in from about eighteen to twenty-two longitudinal rows, a spine springing from each intersection of the mural ridges with the transverse rings. Tabulae complete, horizontal, sometimes slightly concave or convex, often somewhat irregular from the introduction of secondary tabulae; from four to six in a space of 2 mm. When the corallites are not in contact the interven-

ing spaces are crossed by horizontal diaphragms somewhat stouter than, but at about the same distance apart as, the tabulae and showing the same irregularities of growth. The longitudinal ridges appear on the outer surface of the walls, in the spaces between the corallites, as costae; they pass over the edges of the calyces and connect with corresponding ridges in contiguous corallites. The costal ridges at the surface, when the corallites are separate, extend radially but a very short distance, about .5 mm. beyond the confines of the calyces, leaving the surface of the corallum between the corallites smooth; this intercalicular surface is at times marked by obscure, contiguous, polygonal outlines surrounding individual corallites, but no trace of this demarcation is seen in transverse or longitudinal sections. The edges of the calyces are but slightly elevated above the intercalicular surface and in worn specimens appear as smooth raised rings. No definite traces of a basal epitheca have been detected.

Calapœcia Canadensis occurs in the Birdseye and Black River, and Hudson River formations. In the former it is found in the Ottawa district and in the latter on the islands at the north end of Lake Huron, on Snake Island, Lake St. John, Que., and on the Island of Anticosti; it is also found in the Galena-Trenton limestone of the Lake Winnipeg district and of the region to the north. Specimens have been collected at the following localities and have been available for study and comparison. In the Birdseye and Black River, near Ottawa, Ont., E. Billings, at Hull (Ottawa), Que., J. Stewart, 1886; Paquette's Rapids, Ottawa River, T. C. Weston, 1872 and 1881, hill south of Clear Lake (loose), county of Renfrew, township of Sebastopol, R. W. Ells and L. M. Lambe, 1896, near Point Blue, Lake St. John, Que., A. R. C. Selwyn and J. Richardson, 1870. In the Hudson River, north side of Drummond Island, Lake Huron, A. Murray, 1847, Cape Smith and Rabbit Island, Lake Huron, R. Bell, 1859, Wreck Point, Anticosti, J. Richardson, 1856, west side of Gamache (or Ellis) Bay, Anticosti, T. C. Weston, 1865, Snake Island, Lake St. John, J. Richardson, 1857. In the Galena-Trenton, Lower Fort Garry, R. Bell, 1880, T. C. Weston and A. McCharles, 1884, East Selkirk, Manitoba, T. C. Weston, and A. McCharles, 1884; Big Grindstone Point and Deer Island, Lake Winnipeg, J. B. Tyrrell, 1889, first limestone exposure south of Long Point, Lake Winnipeg, D. B. Dowling, 1891, junction of the Churchill Rivers (drift), R. Bell, 1879, Markham Lake, Telzoa River, lat. 62° 44', long. 103°, J. B. Tyrrell, 1893, Herb (Wekusko) Lake, District of Saskatchewan, J. B. Tyrrell, 1896, also Fort Churchill, Hudson Bay (Cambro-Silurian), J. B. Tyrrell, 1894.

The large number of specimens of this genus obtained of late years, and now in the collection of the survey, have convinced the writer that *C. Canadensis* and *C. Huronensis* cannot be retained as distinct species

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seye and Black River, and found in the Ottawa district and of Lake Huron, on Snake and of Anticosti; it is also Lake Winnipeg district and been collected at the following and comparison. In the nt., E. Billings, at Hull Rapids, Ottawa River, T. C. ke (loose), county of Ren- L. M. Lambe, 1896, near Melwyn and J. Richardson, Almond Island, Lake Huron, and, Lake Huron, R. Bell, 1856, west side of Gamache, Snake Island, Lake St. on, Lower Fort Garry, R. t, East Selkirk, Manitoba, indstone Point and Deer limestone exposure south g, 1891, junction of the am Lake, Telzoa River, rb (Wekusko) Lake, Dis- Fort Churchill, Hudson

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and also that between *C. Canadensis* and *C. Anticostiensis* intermediate forms exist connecting these two species. In the specimens from East Selkirk, Manitoba, particularly, a gradual transition can be traced from those specimens, structurally identical with either *C. Canadensis* or *C. Huronensis*, in which the corallites are in contact and polygonal, to those, indistinguishable from *C. Anticostiensis*, in which the corallites are even perhaps slightly farther apart than in the type specimen of that species. On the evidence of these specimens the writer has been forced to regard *C. Canadensis*, *C. Huronensis* and *C. Anticostiensis* as belonging to the same species, no constant structural or other difference having been found that would justify their being kept separate.

GENUS SYRINGOLITES, Hinde. 1879.

(Geological Magazine, decade II., vol. VI., p. 244.)

Corallum broadly expanding, composed of upright, contiguous polygonal corallites, with walls perforated by two or three longitudinal rows of pores; tabulæ funnel-shaped, invaginated and open below so as to form a continuous tube occupying the centre of each corallite; septa represented by numerous tubercles or short spines irregularly disposed on the inner surface of the walls of the corallites; calyces equal, polygonal, of moderate depth.

SYRINGOLITES HURONENSIS, Hinde.

Syringolites Huronensis, Hinde. 1879. Geological Magazine, decade II., vol. VI., p. 246, figs. A, B, C, D.

" " Nicholson. 1879. Palæoz., Tab. Corals, p. 178, fig. 27.

Corallum growing in broad, thick expansions, and according to the author of the species, with a basal epitheca; the only specimen in the collection has a maximum breadth of over 4 inches with a thickness of about 1 inch, it is slightly convex above and flat below. Corallites upright, polygonal, generally with five, six or seven sides, in close contact, thin walled, with an average diameter of 2.5 mm. and placed in communication with each other by mural pores. Tabulæ funnel-shaped, sloping backward toward the centre, where they become tubular, and remaining open below, each tabula connects with the preceding one so as to form a continuous tube, nearly 1 mm. wide, occupying the centre of the corallite; from eight to ten tabulæ occur in a space of 5 mm. Pores rather small, in two or three rows in the sides of the corallites. Septa small, spiniform, present in large numbers, apparently without definite order, on the inner surface of the walls of the corallites; spines similar to these in size and shape and equally abundant occur on the upper surface of the tabulæ and extend into the tube. Calyces rather

equal in size, regularly polygonal, moderately deep, separated from each other by thin, sometimes slightly wavy edges.

Occurs in the Niagara formation near Manitouaning, Grand Manitoulin Island, Lake Huron; the single specimen in the museum of the survey was collected by G. Jennings Hinde.

Dr. Clemens Schlüter* regards *Syringolites* as congeneric with *Romeria*†, Milne-Edwards and Haime, a genus founded for the reception of the species *Calamopora infundibulifera*‡, Goldfuss, from the Devonian of the Eifel. It may be stated, however, that Dr. G. Jennings Hinde¶ had the opportunity of making a close study of the specimens upon which Goldfuss and Milne-Edwards and Haime based their descriptions before making the Canadian coral the type of a new genus.

Genus ROMINGERIA, Nicholson. 1879.

(Paleoz. Tab. Corals, p. 114.)

Quenstedtia, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 70 (Non *Quenstedtia*), Morris and Lycett, 1884.

"Corallum lax, spreading, attached basally, and free throughout the greater part of its extent. Corallites cylindrical, annulated, multiplying by lateral gemmation, and typically producing new tubes in umbellate whorls or verticils, which are placed at short intervals. Where their walls are in contact, their visceral chambers are placed in communication by means of mural pores. Tabulae complete, remote, apparently not distinctly infundibuliform. Septa represented by vertical rows of spinules." (Nicholson.)

ROMINGERIA UMBELLIFERA, Billings, (Sp.)

Autopora umbellifera, Billings. 1859. Canadian Journal, new series, vol. IV., p. 119.

" " Nicholson. 1874. Palae. of Ontario, p. 43, pl. VI., fig. 4.

Quenstedtia umbellifera, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 70, pl. XXXIII., fig. 3.

§ *Autopora umbellifera*, Whiteaves. 1877. Rep. of Progress, Geol. Survey of Canada, 1875-76, p. 317.

Romingeria umbellifera, Nicholson. 1879. Paleoz. Tab. Corals, p. 116, fig. 10.

* Anthozoen des rheinischen Mittel-Devon, von Dr. Clemens Schlüter, p. 99, 1889.

† Monographie des Polypiers Fossiles des Terrains Palaeozoïques par MM. Milne-Edwards et Jules Haime, p. 253. 1861.

‡ Petrefacta Germaniae, von August Goldfuss, pt. I., p. 78, pl. XXVII., figs. 1a, 1b, 1826-33.

¶ Op. cit., p. 245.

§ The fact that the name *Quenstedtia* was preoccupied was pointed out, in 1877, by Mr. Whiteaves (op. cit.), who purposely retained the generic name used by Billings for this species in order to allow Dr. Rominger to substitute another one.

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In the original description of this species Billings remarks: "The parent stems are about one line in diameter, and remain single and straight for the distance of one quarter, or half an inch, when they give off branches in all directions, sometimes ten or twelve at once. These are at first oblique or somewhat parallel with the main tube, and are connected laterally; they then radiate like the spokes of a wheel, at right angles to the parent corallites, each soon giving birth to a similar circlet of new tubes."

Dr. Rominger points out that the parent stem after having given forth a circle of branchlets grows on in a straight line and again produces a similar circle at a higher level; he also mentions that within the group of young corallites the main stem is generally inflated.

In one of the type specimens in this museum a few small circular openings between contiguous branchlets, and between them and the parent stem are plainly seen; these appear to be structural, and are evidently the same as the pores mentioned by Rominger in his description of the species. The tabulæ are irregular in disposition, from 1 to several lines apart; they appear to be generally convex or obliquely transverse. The exterior of the tubes is annulated by striae of equal strength, about eight occurring in a space of 1 line. No septal spines have been observed.

This species was first consigned provisionally to the genus *Aulopora*, by Billings, who stated, however, that it possibly should constitute a new genus. Later this idea was carried out by Rominger, who proposed *Quenstedtia* as the name of a genus for the reception of this species as the type. Unfortunately this name was preoccupied, and Nicholson substituted the name *Romingeria* in its stead, in honour as he says "of one who has so largely contributed to the elucidation of the fossil corals of North America."

Devonian.—Corniferous limestone of Ontario; also from rock of the same age at Long Portage, Missinaibi River.

Genus FLETCHERIA, Milne-Edwards and Haime. 1851.

(Polyp. Foss. des Terr. Palæoz. p. 300.)

"Corallum composed of cylindrical tubes which multiply by calycinal gemmation, and which are not united laterally, either by connecting tubes as in *Syringopora*, nor by mural expansions as in *Thecostegites*; walls strong and furnished with a complete epitheca; calyces circular or sub-circular, with thin edges; septa rudimentary; tabulæ complete, horizontal, well developed." (Milne-Edwards and Haime.)

FLETCHERIA INCERTA, Billings. (Sp.)

Plate I, figs. 8, 8a and 9.

Columnaria incerta, Billings. 1880. Canadian Naturalist, vol. IV., p. 428, figs. 1 and 2.

Corallum in the form of irregularly shaped, somewhat hemispherical masses composed of long, cylindrical corallites that proceed upward and outward, subparallel to each other, from a basal centre. Corallites from .75 to 1.5 mm. in diameter, up to a distance of slightly over 1 mm. apart; although usually circular in transverse section they may become sub-circular when in partial contact or polygonal when crowded together, the walls of individual corallites always remaining distinct from those of contiguous ones. Tabulae numerous, flat or slightly convex or concave, from .5 to 4 or 5 mm. apart. Septa, apparently spiniform, very minute. The corallites have a complete epitheca faintly marked transversely by lines of growth.

Locality and formation.—Mingan Islands, Island of Montreal and near the city of Ottawa. Chazy limestone.

Collectors.—Sir W. E. Logan, J. Richardson and E. Billings. One specimen from St. Charles Island, Mingan Islands, collected by J. Richardson, in 1860, is fully 4 inches in height.

In transverse sections of the tubes the writer has seen what appear to be very small spiniform septa. He has had difficulty in satisfying himself as to whether the increase in growth of the corallum is due to lateral or calicinal gemmation, but the combination of characters is thought to be more in accord with those of *Fletcheria* than with those of any other genus.

Dr. Nicholson* is of the opinion that *Vermipora*, Hall (stated by Rominger to have mural pores) is most nearly allied to, if not an actual synonym of *Fletcheria*.

GENUS NYCTOPORA, Nicholson. 1879.

(Palaeoz. Tab. Corals, p. 182.)

"Corallum composite, massive, of polygonal corallites, which radiate from the base of the spheroidal corallum, to open on its upper surface, and are in complete contact throughout their entire length. Walls of the corallites thin, and so completely amalgamated that no trace whatever of the original lines of division between the tubes can be detected. Mural pores numerous, small, in more than one series, occupying the sulci between the septa. Septa in the form of marginal vertical ridges, which extend

* Palaeozoic Tabulate Corals, p. 70.

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sal centre. Corallites from
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along the whole length of the tubes, from ten to fifteen in number in each corallite, not divisible into an alternating series of longer and shorter lamellæ. Tabulæ numerous, complete, horizontal." (Nicholson.)

The specimens from the typical locality referred to below and about whose specific identity with Nicholson's coral there can scarcely be any doubt, disagree with the generic characters as quoted above in the size, arrangement and number of the septa. In these specimens the septa are distinctly of two sizes, and are sixteen in number, eight very short septa alternating with eight longer ones. It is probable that in the type specimens the septa were not so clearly defined as in those examined by the writer.

NYCTOPORA BILLINGSII, Nicholson.

Plate II., figs. 1, 1a.

Columnaria Goldfussi, Nicholson. 1875. *Palmson*. of Ontario, p. 9. But not *C. Goldfussi*, Billings. 1857.

Nyctopora Billingsii, Nicholson. 1879. *Palmson*. Tab. Corals, p. 184, pl. IX., figs. 3, 3a-c.

Two specimens from Peterborough, Ont., are identified with this species; one is depressed hemispherical and measures $2\frac{1}{2}$ inches across and 1 inch high, the other is somewhat pyriform in shape and is $2\frac{1}{2}$ inches high and $1\frac{1}{2}$ inch broad. Their structure is as follows:—Corallites polygonal, from 1 to 1.25 mm. in diameter, in close contact and without apparently a thorough coalescence of the walls, which are generally of moderate thickness. Septa short, lamellar, sixteen in number, eight primary ones alternating with eight secondary ones; the primary septa, as seen in transverse sections, project about .25 mm. beyond the walls of the corallites toward the centre, and are twice the size of the secondary septa. Tabulæ flat, from two to seven or eight in a space of 2 mm.

Trenton formation.—Collected by Mr. Roger, Peterborough, Ont. The writer has not been able to detect the presence of mural pores in the above two specimens from the typical locality.

SYRINGOPORIDÆ.

Genus SYRINGOPORA, Goldfuss, 1826.

(*Petrefacta Germaniæ*, t. I., p. 75.)

Harmodites, Fisher. 1828. *Notices sur les Tubipores fossiles*, p. 19.

Corallum fasciculate, more or less compact, or lax and spreading, composed of long, cylindrical, generally upright, subparallel, straight or

flexuous corallites that increase by lateral budding and are placed in communication with each other by hollow, cylindrical, horizontal tubes or septa represented by longitudinal rows of small sharply pointed spines. The tabulae are irregularly funnel-shaped, invaginated, generally incomplete, often in the form of cystose plates inclined upward from near the centre of the corallites to the sides, typically leaving a central space; corallites at the base prostrate and either contiguous and forming a leaf-like expansion, or openly reticulated; epitheca with annular growth lines.

The distance apart of the corallites and their thickness vary considerably in different species. The hollow connecting processes are obsolete and replaced by a single circular opening when the corallites by flexure or geniculation are brought into contact with each other. The tabulae are typically somewhat funnel-shaped and form a more or less continuous tube-like space in the centre of the corallites, or they may consist of a variable number of plates resting on each other and curving obliquely upward toward the wall, but so arranged as to leave a central space; the number of cystose plates necessary to complete the circumference of a corallite is very variable. On account of their smallness the spiniform septa are seldom preserved.

SYRINGOPORA VERTICILLATA, Goldfuss.

- Syringopora verticillata*, Goldfuss. 1826. Petrefacta Germaniae, vol. I., p. 76, pl. XXV., figs. 6a, 6b.
 " " Billings. 1858. Rep. of Progress for 1857, Geol. Survey of Canada, p. 170.
 " " Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 79, pl. XXX., figs. 1 and 2.

Billings describes this species as "forming large masses, corallites nearly straight, about two lines in diameter, and from two to three lines distant; connecting tubes three or four lines distant, verticillating, or three or four radiating from the tube at the same level in different directions, like the spokes of a wheel." The specimen from which this description was taken was collected at the head of Lake Temiscaming, Que. (Niagara) by Sir Wm. E. Logan in 1845. The original specimens referred to by Goldfuss are from Drummond Island (Niagara), Lake Huron.

In 1887 additional material was obtained by Dr. R. Bell at the north end of Lake Temiscaming, Que., and in 1893 and 1894 Mr. A. E. Barlow collected specimens on the Isle of Mann (Burnt Island) at the north end of the lake. In these specimens it is seen that the corallites in some individuals are so close together as to be nearly in contact, in which case the connecting bars are almost obsolete; in others the corallites

al budding and are placed in cylindrical, horizontal tubes with small sharply pointed spines at the ends, generally incomplete, often arising from near the centre of the central space; corallites at the ends forming a leaf-like expansion, or growth lines.

their thickness vary considerably. Connecting processes are obsolete when the corallites by flexures meet with each other. The tabulae form a more or less continuous surface, or they may consist of a series of other and curving obliquely to leave a central space; they complete the circumference of a corallite. By their smallness the spiniform

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ta Germanie, vol. I., p. 76, pl.

Progress for 1857, Geol. Survey of

ar. Mich., Foss. Corals, p. 79, pl.

ing large masses, corallites distant, and from two to three lines apart, verticillating, on the same level in different directions. From which this description of Lake Temiscaming, Que. The original specimens from Island (Niagara), Lake

by Dr. R. Bell at the north in 1893 and 1894 Mr. A. E. Mann (Burnt Island) at the time it is seen that the corallites are to be nearly in contact, in some complete; in others the corallites

are not so crowded, or are comparatively distant from each other, as in Goldfuss's figure.

A favourite place for the commencement of the growth of the corallum, as is evinced by the Lake Temiscaming examples, was the rounded upper surface of hemispherically shaped masses of *Favosites*.

Formation.—Niagara.

SYRINGOPORA BIFURCATA, Lonsdale.

Syringopora bifurcata, Lonsdale. 1839. Murch. Sil. Sys., p. 685, pl. 15 bis. figs. 11, 11a, 11b.

Growing in masses composed of upright, slightly geniculated corallites averaging $1\frac{1}{2}$ line in diameter and at times nearly as much as 3 lines apart. The geniculations of the corallites are on an average about 5 lines apart, and on account of these changes in the direction of their growth, the corallites are frequently brought almost into contact with each other. Connecting bars or tubes, stout, short, occurring at the geniculations or where the corallites are close together, or if the corallites are comparatively strait and parallel to each other, about 3 or 4 lines apart. The outer surface of the corallites is roughened by moderately strong but irregular annulations. In other respects this species presents nothing unusual in its structure.

Niagara formation.—Cape Wingfield, Lake Huron. A. Murray. 1861; Isle of Mann (Burnt Island), Lake Temiscaming, Que. A. E. Barlow. 1893.

Lower Helderberg group.—L'Anse à la Vieille, Que. R. Bell. 1862 (identified by E. Billings); "The Forks" Scaumenac River, Que., and 1 mile east of the Little Cascapedia River, Que., R. W. Ellis. 1883.

SYRINGOPORA DALMANII, Billings.

Plate II., fig. 2.

Syringopora Dalmanii, Bill. 1858. Rep. of Progress, for 1857, Geol. Survey of Canada, p. 169.

"Forming large masses; corallites long, sub-parallel, slightly radiating, occasionally a little flexuous, annulated, one line or rather more in diameter, distant usually half a line, occasionally in contact or where flexures occur, more than one line apart; connecting processes very short, about two lines distant." (Billings.)

This species differs from *Syringopora bifurcata*, Lonsdale, principally in having a more compact and less robust form of growth; the corallites are straighter, closer together and of smaller diameter.

Niagara formation.—Head of Lake Temiscaming, Que. Sir Wm. E. Logan; north end of Lake Temiscaming Que. Dr. R. Bell. 1887.

SYRINGOPORA RETIFORMIS, Billings.

Plate II., fig. 3.

Syringopora retiformis, Billings. 1858. Rep. of Progress for 1857, Geol. Survey of Canada, p. 170.

" " Nicholson. 1874. Paleon. of Ont. p. 58.

Syringopora tenella, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 80. pl. 30, fig. 4.

"Forming large masses; corallites much geniculated, frequently anastomosing or connecting by stout processes; diameter of corallites about two-thirds of a line, distant from each other from half-a-line to a line and a half; distance of connecting processes one line to three lines, usually about two lines."

In this species, as in some others of the genus, the corallites show a certain variation in the regularity of their growth, especially in the basal portion of a corallum; instead of the corallites being in a general way parallel to each other they are sometimes lax in their mode of growth, a result probably due to disturbing influences during the life of the coral. This laxity of growth is apparent in a specimen from Owen Sound, Ont., which bears a striking resemblance to *S. tenella*, Rominger, as figured on plate XXX. of the Fossil Corals of Michigan. One of the principal characteristics of *S. tenella*, from the Niagara of Point Detour, Michigan and Drummond Island, Lake Huron, is the coming together of the corallites without the intervention of connecting tubes, a feature particularly noticeable in the above mentioned example of *S. retiformis* from Owen Sound. In other examples of *S. retiformis*, in which there is a more general parallelism of the corallites, it is difficult frequently to determine whether there are short connecting tubes present, or whether the corallites are in juxtaposition, at the geniculations. The corallites in *S. retiformis* are described as being "much geniculated, frequently anastomosing or connecting by stout processes." Judging from Dr. Rominger's description and figure the writer is led to believe that *S. tenella*, Rominger, is the same as *S. retiformis*, Billings. It may be well to state that the Niagara rocks extend in an apparently unbroken line from Point Detour and Drummond Island eastward to Owen Sound.

Niagara group.—Isthmus Bay, Lake Huron. A Murray; lot 13, concession 7, Derby township, county of Gray, R. Bell; Owen Sound, Ont., J. Townsend, 1882.

Waukegan, Que. Sir Wm. E.
e. Dr. R. Bell. 1887.

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ogress for 1887, Geol. Survey of

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SYRINGOPORA INFUNDIBULA, Whitfield.

Syringopora infundibula, Whitfield. 1877. Ann. Rept. Geol. Surv., Wis., p. 79.
Cystostylus infundibulus, Whitfield. 1882. Geol. of Wisconsin, p. 274, pl. XIV., fig. 7.
Cystostylus infundibulus, Whiteaves. 1884. Palaeoz. Foss. vol. III., pt. I., p. 2 and 1895,
pt. II., p. 49.

Cystostylus infundibulus is described (op. cit.) as having "transverse diaphragms represented only by deeply funnel-formed, imperfect plates or cysts, appearing on the broken surface as a series of deep inverted cones or funnels, placed one within the other so closely as to produce by their united tubes an almost or quite continuous columella along the centre of the corallite; the cystose plates are never continuous around the whole circumference, but are so closely arranged that from two to four may be counted in a length equal to the diameter of the tube."

The tabulae in the corallites of *Syringopora* are generally stated to be funnel-shaped. Nicholson, in the Palaeozoic Tabulate Corals, p. 208, qualifies this by describing them as "well developed, usually more or less regularly funnel-shaped, and often giving rise to a more or less continuous tube occupying the axis of the visceral chamber." On p. 211 of the same work excellent figures are given of the corallites of *S. reticulata*, Goldfuss (the type of the genus) as seen in longitudinal and horizontal sections showing the inner structure. The tabulae are here shown to be imperfectly funnel-shaped, as a rule not continuous round the inner circumference of the corallites and to have their regularity broken at times by the introduction of cysts or blisters such as are found in *Cystiphyllum*. The inner structure of the corallites, as shown in these figures, is a fair example of what is to be found in most of the Palaeozoic species of *Syringopora* in Canada.

Judging from the figure appended to the description of *Cystostylus infundibulus*, Whitfield, there is nothing in the structure of this coral, in the writer's opinion, to necessitate its removal from the genus *Syringopora* as generally understood. It is possible that *Cystostylus infundibulus* may be found to be not distinct from *S. verticillata*, Goldfuss.

The coral described by Prof. R. P. Whitfield occurs in the upper part of the Niagara group of Wisconsin, in the vicinity of Wauwatosa and Milwaukee. It is stated to have been found only in the solid limestone, the inner structure being revealed on fractured surfaces but the exterior surface of the corallites has not been seen.

In specimens of this species from the Guelph formation at Durham, Ont., the coral is preserved in a manner similar to that of the Wisconsin specimens. The general disposition of the corallites with their connecting tubes is well shown, as is also the inner structure.

Guelph formation.—Durham, Ont. J. Townsend, 1883.

Mr. Whiteaves has recorded the occurrence of this species at New Hope (now called Hespeler), E. Billings, 1857; Elora, David Boyle; as well as at Durham, J. Townsend, 1883.

SYRINGOPORA COMPACTA, Billings.

Syringopora compacta, Billings. 1858. Rep. of Progress for 1857, Geol. Survey of Canada, p. 100.

"Forming large hemispherical masses of straight parallel or slightly diverging corallites, which are so closely aggregated as to compose a nearly solid mass; about six corallites in two lines.

"This species differs from all others of this genus hitherto described in the closeness of the corallites. These are so small, straight and closely united that large masses broken in the longitudinal direction of the tubes have the aspect of some species of *Monticulipora*." (Billings.)

In *Syringopora compacta* the corallites are seldom more than .33 mm. apart and often at frequent intervals they are contiguous. The connecting tubes are necessarily very short, and, when the corallites touch each other, they are replaced by circular openings like the pores of *Favosites*. The average diameter of the corallites is about .66 mm. The corallites seen in longitudinal section present the usual deeply depressed or irregularly funnel-shaped diaphragms distinctive of the genus.

Lower Helderberg formation.—L'Anse à la Vieille, Que. Sir Wm. E. Logan. 1843.

SYRINGOPORA MACLUREI, Billings.

Syringopora tubiporoides, Billings. 1858. Rep. of Progress for 1857, Geol. Survey of Canada, p. 171.

" " Billings. 1859. Canadian Journal, new series, vol. IV., p. 115, fig. 17.

Aulopora cornuta, Billings. 1859. Ibid. vol. IV., p. 118, fig. 20.

Syringopora Maclurei, Billings. 1860. Ibid. vol. V., p. 258.

" " Billings. 1863. Geology of Canada, p. 366, fig. 366.

" " Nicholson. 1874. Palæon. of Ont., p. 41.

" " Nicholson. 1875. Geol. Surv. of Ohio, vol. II., p. 241.

" " Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 82, pl. XXXI., figs. 1, 2 and 3.

"This species is found in large masses of long slightly flexuous corallites. These have a diameter of about one line and a half, and owing to their flexuosity, are at times in contact, and often two, three or four lines apart. In large colonies which have grown luxuriantly without the interference of disturbing causes, the corallites are more regular than in the smaller or

Yvnsend, 1883.

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stunted groups, in which the corallites are much bent and confused. The connecting processes are very short and distinct, and appear to be sometimes mere inosculation of the stems. The corallites after growing separately for a short distance, approach each other and seem to grow together or adhere to each other for the space of a line and a half or more, they then diverge and again unite. These points of contact occur at distances varying from three lines to six, nine, or even twelve lines. Externally they exhibit numerous other indistinct annulations, and also faint indications of longitudinal striae." (Billings.)

In 1860 Mr. Billings, who had previously identified this species with *S. tubiporoides*, Yandell and Shumard, found that it was really quite distinct and proposed the specific name *Maclurei* for the Canadian coral. He also qualified the original description by stating that the average diameter of the corallites is more nearly one line than one line and a half (vide Can. Jour., vol. V).

The exterior of the corallites of this species presents a rather smooth surface, the annulations or lines of growth being faint and indistinct, but indications of longitudinal striae have not been observed by the writer. The diameter of the corallites varies in different specimens from $1\frac{1}{2}$ to 1 line, and there is a certain amount of variation in individual specimens; the average thickness appears to be slightly over 1 line or about 2.5 mm. In specimens with very flexuous corallites the growth seems to be more robust than when the corallites are comparatively straighter and closer together. Connecting tubes proper, though seldom seen, are short and stout, most frequently the corallites touch each other and are brought into communication with each other without the intervention of tubes.

The writer has examined the type specimens of *Aulopora cornuta*, Billings, in the museum with a view to the elucidation of, if possible, some of its characters. The fossils are fragments only and have been damaged by the action of acid so that many details of structure are lost. On a close examination, however, the broken ends of some of the tubes show what appear to be the remains of "infundibuliform tabulae," seen in cross section, with evidences of a central tube. Also, a longitudinal section obtained by rubbing down one of the branches, revealed the usual syringopora-like structure, from which the writer is led to believe that this fossil should properly be referred to the genus *Syringopora*. Further, a comparison of the types of *Aulopora cornuta* with examples of *Syringopora Maclurei*, Billings, suggests the probability that the former species was founded on portions of the basal growth of the latter species.

Dr. Rominger (op. cit, p. 71) regards *A. cornuta* as a synonym of *Romingeria umbellifera*, but seems to be guided entirely by external char-

acters. In the writer's opinion he does not prove conclusively that the fossils described by Billings are referable to *R. umbellifera*, in fact the inner structure of the types of *A. cornuta* leads to quite a contrary conclusion.

Devonian.—Abundant in the Corniferous limestone of Ontario. Also Long Portage, Missinaibi River to Moose Factory (Corniferous), R. Bell, 1877.*

SYRINGOPORA PERELEGANS, Billings.

Plate II., fig. 4.

- Syringopora elegans*, Billings. 1868. Rep. of Progress for 1857, Geol. Survey of Canada, p. 172.
Syringopora perelegans, Billings. 1857. Canadian Journal, new series, vol. IV., p. 117, fig. 19.
 " " Billings. 1863. Geology of Canada, p. 366, fig. 368.
 " " Nicholson. 1874. Palaeon. of Ont., p. 41.
 " " Rominger. 1876. Geol. Sur. of Mich., Foss. Corals, p. 81, pl. XXXI., part of fig. 2 and fig. 4.†

"Corallites one line in diameter, sometimes a little more or less, distant a little less than one line, connecting tubes half a line in diameter, and distant from one line to one line and a half, usually projecting at right angles, but sometimes a little oblique. Epithecæ with numerous annulations, generally indistinct, but under certain circumstances of growth sharply defined and deep, so much so as to give to the corallites the appearance of the jointed stalk of a crinoid. The young individuals are produced by lateral budding, and in one specimen examined the whole colony appears to be based upon a broad lamellar foot secretion like that which forms the base of a Favosite.

"The distance of the corallites is usually about a line, but like all the other species, this one varies a good deal in this respect. When some cause has intervened to prevent their regular growth they are much flexed, and consequently at times more distant than when they have been undisturbed. The connecting tubes on the same side of the corallite are three or four lines distant, but generally on the other sides one or two others in the same space occur, making the average distance one line or one line and a half." (Billings.)

* Geol. Survey of Canada, Rep. of Progress for 1877-78, p. 56, Provisional list of fossils collected between the Long Portage of the Missinaibi branch of the Moose River and Moose Factory, by Mr. Whiteaves, in Dr. Bell's Report on the east coast of Hudson's Bay.

† Fig. 3, pl. XXXI., evidently represents a specimen of *S. Maclurei*, Bill.

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3, p. 5c, Provisional list of
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The corallites of this species are as a rule moderately straight and seldom approach each other close enough to be in contact, they are connected together by straight tubes of about half the thickness of the corallites themselves, and are frequently deeply constricted at intervals of about 1.2 mm., sometimes more and often less. In some specimens the corallites are often two lines apart.

From different specimens in the survey collection it is seen that the base of the corallum may consist of an open reticulation of prostrate corallites, or that the corallites, diverging from one or more centres and closely packed together in one plane, may form a single undulating leaf-like horizontal basal expansion, with at times secondary ones parallel to and at no great distance above the main one. Dr. Rominger figures* a portion of the latter form of basal expansion of this species; the sudden up-bending of the corallites is well shown.

The name of this species was changed by Mr. Billings from *S. elegans* to *S. perelegans*, the former name being preoccupied, as stated in a footnote on page 117 of volume IV, of the Canadian Journal.

This species differs from *S. Maclurei* in having corallites that are slenderer, much more strongly annulated, straighter and therefore more nearly parallel to each other, and in having the connecting tubes more highly developed. Dr. Nicholson considers it to be nearly related† to *S. reticulata*, Goldfuss, from the Carboniferous rocks of Europe.

Devonian.—Abundant in the Corniferous limestone of Ontario. Long Portage, Missinaibi River to Moose River (Corniferous), R. Bell, 1877.

SYRINGOPORA HISINGERI, Billings.

Syringopora Hisingeri, Billings. 1858. Rep. of Progress for 1857, Geol. Survey of Canada, p. 172.

" " Billings. 1859. Canadian Journal, new series, vol. IV., p. 116, fig. 18.

Aulopora Aliformis, Billings. 1859. Canadian Journal, new series, vol. IV., p. 119, (not of Nicholson.)

Syringopora Hisingeri, Billings. 1863. Geology of Canada, p. 366, fig. 367.

" " Nicholson. 1874. Paleon. of Ont., p. 40.

" " Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 84, pl. XXXII.

Aulopora Aliformis, Whiteaves. 1891. Contr. to Can. Paleon, vol. 1, pt. III., p. 211, pl. XXIX., fig. 1.

"This species forms large masses of very long, nearly parallel or slightly varying, slender corallites, which are closely aggregated and

*Op. cit. vide supra, fig. 2.

†Paleontology of Ontario, p. 41. 1874.

present a rugged or knobby appearance from the great number of the connecting tubes. The diameter of the corallites is one-third of a line or a little more. The tubes of connection are distant from two-thirds of a line to one line and a half. The distance between the corallites is for the greater part less than their diameter. The young corallites branch from the sides of the adult individuals, and immediately become parallel with the parent, and connected with it again by the usual tubes of connection." (Billings.)

S. Hisingeri seems to have had, as a rule, a comparatively small base of attachment and to have had an upright growth with the height much greater than the breadth. As in *S. perelegans*, the corallum began its growth as an aggregation of flattened, prostrate corallites, forming a lamellar or an open reticulated base, from which at regular intervals the corallites ascend by a sudden upturn. The corallites in some specimens reach a thickness of half a line.

Mr. Billings was of the opinion that this species is closely allied to Edwards and Haime's *S. Verneuili* and *S. Cleviana*, both from the Onondaga and Corniferous limestones of Ohio. Unfortunately the Ohio specimens were not figured, and in the case of the last named species the description is very meagre and altogether inadequate. As regards *S. Verneuili* it differs, judging from the very short description, from *S. Hisingeri* in having its corallites much farther apart. In the numerous specimens belonging to the collection of this survey, the corallites are seen to be almost always separated by a space equal to or less than their diameter, whereas in *S. Verneuili*, the corallites are said to be distant two or three times their diameter.

Devonian.—Found in the Corniferous limestone of Ontario; Long Portage, Missinaibi River to Moose Factory (Corniferous), R. Bell, 1877.*

An examination of the type of *Aulopora filiformis*, Billings, has led to the conclusion that it belongs to the genus *Syringopora* and is most likely the basal reticulation of *Syringopora Hisingeri*, Billings. The specimen described by Billings is adherent to and covers a dorsal valve of *Strepatorhynchus Pandora*, Bill. with an open reticulation of prostrate tubes which are attached to the shell by the entire lower surface. Toward the centre and on one side of the reticulation the tubes rise to a greater height than elsewhere and are connected together by transverse processes. The broken ends of some of the tubes show in transverse section what appears to be a syringopora-like structure, viz.: the remains of a central tube and of, though less clearly, invaginated tabulae. On account of the slenderness of the tubes and the damage already done to the specimen by having been

* See foot-note on page 56.

from the great number of the corallites is one-third of a line. They are distant from two-thirds of a line. The young corallites branch and immediately become parallel by the usual tubes of connection.

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stone of Ontario; Long Port- (iferous), R. Bell, 1877.*

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mersed in acid, it was found impracticable to obtain a longitudinal section of them. The presence alone of transverse bars connecting adjacent corallites would probably justify, without further corroboration, the conclusion that in *Aulopora filiformis* we have a true *Syringopora*.

A comparison of the basal reticulation of one of the types of *Syringopora* *isingeri*, Billings, with the type of *A. filiformis*, shows the resemblance between the two to be so strong as to scarcely leave any doubt as to their being specifically identical.

That *A. filiformis*, Billings, is in all probability a *Syringopora* was first suggested by Mr. Whiteaves in 1891 (op. cit. p. 211). At this time, describing *Hederella Canadensis*, Nicholson, he had occasion to refer to *A. filiformis*, Billings, and in connection with the latter species remarks that it appears to him "to be the immature state of a species of *Syringopora*."

The type specimen of *A. filiformis* bears the label Rama's Farm, Port Colborne, Ont., Corniferous limestone; E. Billings.

SYRINGOPORA NOBILIS, Billings.

- Syringopora nobilis*, Billings. 1858. Rep. of Progress for 1857, Geol. Survey of Canada, p. 171.
 " " Billings. 1859. Canadian Journal, new series, vol. IV., p. 118.
 " " Nicholson. 1874. Palæon. of Ont., p. 40.
 " " Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 84, pl. XXXII.
 " " Whiteaves. 1889. Contr. to Can. Pal., vol. I., pt. II., p. 120.

The original description of this species is as follows—"Corallites three lines in diameter, distant two to four lines. The connecting processes in this species have not been observed, but the size of the corallites is quite sufficient to separate it from any known species." In 1859, Mr. Billings (Can. Jour., vol. IV.) further says "This species is distinguished from all others of the genus by the great size of the corallites, which sometimes attain the diameter of five lines. In the young state the form is that of an *Aulopora*, but the adult specimens have branches three or more inches in length, with an internal arrangement of infundibuliform diaphragms, which are so blended together as to produce a structure somewhat similar to the vesicular tissue of the genus *Cystiphyllum*. The external wall is thick and rather strongly annulated."

Nicholson in the Palæontology of Ontario refers to this species in the following words—"Corallum lax, spreading, increasing by the production of lateral buds. Corallites very large, varying with age from one and a half to five lines in diameter, apparently not connected by transverse processes. Septa obsolete; tabulæ infundibuliform. Epitheca

thick, with encircling striæ and stronger annulations." He also considers it doubtful "if the species can with propriety be retained under *Syringopora*" principally on account of the apparent absence of transverse connecting tubes.

In the individuals upon which the original description was based connecting tubes were not seen, but Dr. Rominger (op. cit) figures a specimen in which a horizontal process connecting two corallites is clearly shown, proving beyond doubt that this coral has been properly referred to the genus *Syringopora* and that connecting tubes, though not generally seen, are still sometimes present.

From the specimens in the collection of this survey it is seen that on the inner surface of the corallites there are about twenty longitudinal rows of short septal spines. In each row the spines are about 0.5 mm. apart. The inner arrangement of upwardly and outwardly curved plates, which in the original description of the species are referred to as "infundibuliform tabulæ," is identical with that which is found in other species of the genus, and the more or less central space frequently left by the inclined imperfect tabulæ, and sometimes referred to as a "central tube" is also seen.

Devonian.—Corniferous limestone of Ontario; also in the Hamilton formation of Ontario.

SYRINGOPORA INTERMEDIA, Nicholson.

Syringopora intermedia, Nicholson. 1874. Palæon. of Ont., p. 126.
" " Whiteaves. 1889. Contr. to Can. Palæon., vol. 1, pt. II., p. 120.

"Corallum lax, spreading, increasing by the production of lateral buds. Corallites cylindrical, often more or less crooked, having a diameter of from one line to a line and a half, or rarely two lines, the lateral buds being produced at angles of from 90° to 40°, and at intervals of from two to four lines. No connecting horizontal processes between the corallites, but sometimes abortive spines or nodes. Epitheca with fine encircling striæ, and irregular growth-swellings and geniculations. Internal structure, of infundibuliform tabulæ." (Nicholson.)

The largest specimen seen by the writer was collected by Johnson Pettit, in the township of Bosanquet, Ont., in 1868; it is 4 inches long, 2½ inches broad, with a maximum height of 2½ inches and is evidently only a portion of the corallum. The corallites have an average diameter of 1½ line and are about from 1 line to 1½ line from each other, although they are frequently closer together and often coalesce. The corallum grows upward in an irregular manner from a spreading, prostrate net-

annulations." He also considers that they may be retained under *Syringopora* on account of the absence of transverse con-

al description was based on a specimen (op. cit.) which figures a specimen consisting of two corallites is clearly that it has been properly referred to as a "central" tube, though not generally

in this survey it is seen that on the average about twenty longitudinal spines are about 0.5 mm. apart and outwardly curved plates, which are referred to as "central" plates, which is found in other specimens referred to as a "central"

also in the Hamilton

Nicholson.

Ont., p. 126.

Can. Palæon., vol. 1, pt. II.,

production of lateral buds. The lateral buds, having a diameter of about 0.5 lines, the lateral buds are at intervals of from two to three lines between the corallites, and are enclosed with fine encircling geniculations. Internal (op. cit.)

as collected by Johnson in 1868; it is 4 inches long, 1.5 inches wide and is evidently a single corallite with an average diameter of about 1.5 lines from each other, although they may coalesce. The corallum is prostrate net-

work of rapidly budding corallites; the irregularity of growth is caused by the constant twisting of the corallites, and the giving off of many young corallites at different angles. One specimen in the collection shows a basal reticulation, about three by two inches across, adherent to the upper surface of a *Favosite*.

Devonian.—Hamilton formation; township of Bosanquet, county of Lambton, Ont., Johnson Pettit, 1868, and Thedford, Ont., Rev. Hector Currie, 1882.

SYRINGOPORA RETICULATA, Goldfuss.

Syringopora reticulata, Goldfuss. 1826. Petrefacta Germaniæ, vol. I., p. 76, pl. XXV., fig. 8.

" " Nicholson. 1879. Palæoz. Tab. Corals, p. 215, fig. 30 and pl. X., fig. 5.

Syringopora (?) species, Whiteaves. 1877. Rep. of Progress for 1875-76, Geol. Survey of Canada, p. 98.

A specimen of *Syringopora*, referable to this species, was collected by Dr. A. R. C. Selwyn, at Fossil Point, on the Peace River, B.C. The corallites are slightly flexuous, about $\frac{1}{2}$ of a line (1.7 mm.) in average diameter, and distant from $\frac{1}{2}$ line to 1 line from each other; they are connected together by numerous moderately slender transverse tubes from 1 to 2 or 3 lines apart. In longitudinal and transverse sections the usual invaginated plate structure is seen.

The specimen of *S. reticulata* figured by Goldfuss is from Olne, in the province of Limbourg (lower Carboniferous) and Nicholson regards this species as one of the most characteristic fossils of the Carboniferous limestone of England. The rocks occurring at Fossil Point have been referred to by Mr. Whiteaves (op. cit.) to the Devonian or Carboniferous formations.*

Devono-Carboniferous.—Fossil Point, Peace River, B.C. A. R. C. Selwyn. 1875.

SYRINGOPORA RAMULOSA, Goldfuss.

Syringopora ramulosa, Goldfuss. 1826. Petrefacta Germaniæ, vol. I., p. 76, pl. XXV., fig. 7.

" " McCoy. 1855. Brit. Palæoz. Foss., p. 83.

" " Edwards and Haime. 1861. Polyp. Foss. des. Terr. Palæoz., p. 289.

In the collection of this survey, is a specimen of *Syringopora* which appears to agree better with this species than with any other. Its corallites average in diameter about $1\frac{1}{2}$ line; they are slightly flexuous, often

*See reference to the "Banff limestones," on the next page.

almost touch each other, but are seldom distant more than 1 line. Transverse connecting tubes occur at rather long intervals. The inner structure is well preserved and consists of more than usually large incline plates (funnel shaped tabulae).

The Canadian fossil differs from the type of *S. ramulosa* principally in the corallites being somewhat straighter, and in there being apparently fewer connecting tubes. The principal point of agreement is the size of the corallites. The characters of the species as set forth by McCoy (op. cit.) sustain the writer in the opinion that the coral under consideration is in all probability more properly referable to this species than to any other of the genus.

S. ramulosa occurs in the Lower Carboniferous or mountain limestone of England (the "Eubergangskalk" of Goldfuss).

The specimen here referred to was collected in 1879, from the "Lower Banff limestone" by Prof. John Macoun, in the Bow River Pass, Alberta, about fifteen miles west of Morley, at the "Gap."

The "Lower Banff limestone" is a term applied by Mr. McConnell to the lowest division of a series of limestones and shales of Carboniferous age found in the valley of the Bow River. It immediately overlies limestones that in his opinion represent the Devonian in that locality. Mr. McConnell also believes that the limestones of Fossil Point, Peace River, from which the specimen of *S. reticulata* previously mentioned, was obtained, are the same as those found at the base of the Banff limestones in the Bow River Pass.

GENUS CANNAPORA, Hall.

The generic characters of this genus are given by Rominger (Fossil Corals of Michigan) in the following words,— "Colonies of closely approximated erect tubules, with stout walls, sprouting from an incrusting basal expansion formed of prostrate tubules growing and multiplying in the same manner as an *Aulopora*. The erect ends of the tubules are annulated by wrinkles of growth and by sharp-edged, periodical offsets marking an interruption and renewed growth from the inner circumference of the old orifices. The sides of the tubes are partly connected by horizontal expansions of the walls, partly in direct contiguity, in which latter case the otherwise circular tubes are pressed into a polygonal shape, and connect in the contiguous parts by lateral pores. The orifices are slightly dilated at the margins, radiated by twelve spinulose projections, rows of which extend through the whole length of the tubes. Diaphragms are not often developed,* direct transverse, and not funnel-shaped as in *Syringopora*."

* The diaphragms are, judging from specimens from Ontario, horizontal, numerous and placed rather close together, but are frequently not preserved.

distant more than 1 line. Transverse intervals. The inner structure more than usually large inclining

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Hall.

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Ontario, horizontal, numerous preserved.

CANADIAN PALÆOZOIC CORALS.

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CANNAPORA JUNCIFORMIS, Hall.

- Cannapora junciformis*, Hall. 1852. Palæon. New York, vol. 11, p. 43, pl. XVIII., figs. 1a-f.
Cannapora annulata, Nicholson and Hinde. 1874. Canadian Journal, new series, vol. XIV., p. 154.
 " " Nicholson. 1875. Palæon. of Ont., p. 58.
Syringopora junciformis, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 85, pl. XXXIII., fig. 4.
Syringopora fibrata, Rominger. 1876. Ibid, p. 81, pl. XXX., fig. 3.

The original description and figures of this species and the general characters assigned to the genus, of which this species is the type, are necessarily imperfect on account of the poor state of preservation of the specimens primarily at Professor Hall's disposal.

The Niagara rocks of Ontario have yielded specimens in which the general form of growth is seen to better advantage and the inner structure is more clearly defined. A certain amount of variation, often accentuated by the state of preservation of the fossils, is noticeable in the size of the corallites and in the surface markings.

In this species the corallites are very close together, parallel, nearly straight, and annulated by more or less well defined sharp-edged ridges which are prolonged at intervals and serve as a means of connection between contiguous corallites. The base evidently adhered to foreign objects and is made up of an aggregation of close-set, prostrate corallites, diverging from one or more centres and forming a crust from which the corallites at regular intervals grew erect. This basal lamellar expansion is formed on the same principal as that of some species of *Syringopora*. Corallites from about 0.75 to 2 mm. in diameter in different specimens. Tabulæ rather regular in disposition, horizontal, close set. Septa spiniform, occurring in about twelve longitudinal rows.

The corallites in the specimens available for study in this museum show a decided variation in the amount of development of the annulations as well as in the size of the corallites themselves. One example from the vicinity of Owen Sound, Ont., bears a strong resemblance to the specimen figured by Hall (op. cit. pl. XVIII., fig. 1b) in having comparatively smooth tubes, another from the same locality, with strongly annulated corallites, agrees more with the form described by Nicholson and Hinde under the specific name *annulata* but which is, in the writer's judgment, not separable from Hall's species, or at the most could only be regarded as a variety.

Syringopora fibrata, Rominger (op. cit.) from the Niagara of Drummond Island, Lake Huron, seems to belong to this species, and is represented, in the museum collection, by some specimens from this

locality as well as from the vicinity of Owen Sound, Ont. These specimens are silicified, and in many cases deceptive in appearance on account of the apparent smaller diameter and greater distance apart of the corallites. The apparent smallness of the corallites is due to the fact that in some cases the silicious casts only of the tubes remain, which are connected together by horizontal processes. These connections are evidently the casts of the "lateral pores" by which, according to Rominger, the contiguous corallites of *Cunnapora* are placed in communication with one another. In a specimen from Owen Sound, a weathered surface presents the appearance of *Syringopora fibrata*, but on the other side of the same specimen, where the corallites have been less exposed, the true characters of the coral are apparent. On the weathered side comparatively distant casts of corallites, about .5 mm. in diameter, are seen, whilst on the other side the corallites themselves are shown, about 1 mm. in average diameter, very close together and indistinguishable from specimens of *Cunnapora junciiformis* from the same locality, in which the more or less annulated tubes, horizontal tabulae and spiniform septa are better preserved.

Niagara formation.—Loc. 13, concession 2, township of Derby, county of Grey, Ont., R. Bell and at Owen Sound, Ont., J. Townsend. 1874.

2. ALCYONARIA.

HALYSITIDÆ.

GENUS HALYSITES, Fischer. 1813.

(Zoognosia, 3rd ed., t. 1, p. 387.)

Catenipora, Lamarck. 1816. Hist. des An. sans Vert., t. ii., p. 206.

Corallum reticulate and fasciculate, made up of long, upright, cylindrical corallites that are either joined to each other by their edges in a chain like series so as to form vertical, anastomosing laminae inclosing interspaces of variable size, or the laminae are approximated so that their corallites are contiguous or nearly so, while the interspaces are reduced to a minimum; between each pair of corallites in any particular lamina a tubule is generally present, parallel to and of the same length as the corallites; tabulae numerous, complete, horizontal, occurring both in the corallites and the tubules; septal spines in twelve longitudinal rows in the corallites; a horizontally striated epitheca covers the free sides of the corallites.

Of the genus *Halysites* two species are known to occur in Canada, viz., *H. catenularia*, L. and *H. compacta*, Rominger.

Owen Sound, Ont. These deceptive in appearance and greater distance apart of the corallites is due to the fact the tubes remain, which are seen. These connections are which, according to Romer are placed in communication. In Owen Sound, a weathered surface is seen, but on the other side of the rock, which has been less exposed, the true structure of the weathered side compared with the unweathered side. The corallites, in diameter, are seen to be of different sizes, as shown, about 1 mm. in diameter, and indistinguishable from specimens from other localities, in which the more regular septa are better seen.

township of Derby, county of Huron, Ont., J. Townsend. 1874.

1813.

387.)

ii., p. 206.

of long, upright, cylindrical corallites, which are separated by their edges in a series of inclosing laminae inclosing the corallites so that their interspaces are reduced to a minimum. Any particular lamina is of the same length as the corallites, occurring both in the longitudinal rows in the corallum and on the free sides of the

to occur in Canada.

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Taking into consideration the first named species, it is seen that specimens of this coral differ materially, not only in the size and shape of the corallites and the meshes or spaces which they inclose, but if the inner structure is studied by means of longitudinal and transverse sections, it will be apparent that differences exist here also.

The size and form of the corallites and meshes have been used as a basis for the separation of the "chain-coral" into species and varieties, and Professor H. Alleyne-Nicholson has proposed an arrangement dependent on the internal structure, still there remains some doubt as to whether a number of well defined species exist or whether there is only a single species with perhaps some varieties.

If an arrangement according to the outside form be attempted, or if the inner structure be relied on only as a basis for classification, it will be found almost impossible to arrive at satisfactory conclusions.

The variations in the general manner of growth of the corallum (caused by the size and shape of the corallites and inclosed spaces) and the marked differences to be found in the inside structure, appear to be sufficiently constant at different geological horizons to allow of varieties with certain characteristics being considered distinctive of the horizons in which they are found.

The examination of a large number of Canadian specimens shows that not only do they vary in the size and shape of their corallites and of the inclosed spaces, but they also differ in their internal structure to a very considerable extent, with variations between the extreme forms. As regards the mere outward shape so great a diversity exists that it is almost possible to trace a gradual transition of such forms with small corallites and meshes as *H. catenularia* var. *micropora*, Whitfield, to those with large corallites and meshes similar to *Catenipora labyrinthica* of Goldfuss. In the same individual the size and shape of the meshes may change to a marked degree: as for example, in a specimen from the Niagara limestone of Ontario, the manner of growth is found to be similar in one portion of the corallum to that of *H. escharoides*, Lam., as figured by Goldfuss, with small but rather regularly shaped meshes and in another part to that of *H. agglomerata*, Hall, with rows of corallites running in parallel lines. The corallum seems to have adopted the latter mode of growth when its lateral expansion was interfered with or restricted.

The corallites show a marked difference in their size and shape as seen in horizontal section. In a specimen from the Lower Helderberg rocks near the mouth of the Little Cascapedia River, Que., the corallites measure as much as 4 mm., by 2.5 mm., but in another specimen from the north-east side of the Columbia River near

Donald, B.C. (Silurian) they do not exceed .7 mm. by .45 mm. in size; between these extreme forms may be found specimens with corallites of various sizes. Corallites that are markedly quadrangular in transverse section are met with, as well as those, in different specimens, that are almost quadrangular, oval, both broadly and narrowly oval and circular, whilst both circular and oval corallites frequently occur in the same specimen. *H. gracilis*, Hall, was separated as a distinct species principally on account of its corallites being "quadrangular" as seen in horizontal section; as will be seen further on, there are other reasons for still considering it as distinct from the typical form of *H. catenularia*, at least as a variety indicative of distinct geological horizons.

If after finding so many transitions in outward appearance between extreme forms of this coral as to render a specific classification upon this basis alone extremely difficult, if not impossible, one passes on to an examination of its internal structure, difficulties arising from transitional changes are again met with. Nicholson has adopted a classification of the different forms based on a microscopical study of the internal construction, and has separated them into two groups; in one he places those forms in which the corallites are found apparently contiguous, in the other those having a tabulate space of variable width separating the corallites. In his "Manual of Paleontology," 3rd ed. vol. I., p. 339, Dr. Nicholson observes "The species of *Halysites* may be divided into two groups, according as the corallum is composed throughout of corallites of one size or consists of two sets of corallites of different sizes. The common *H. escharoides* of the Silurian rocks is an example of the forms in which the corallites are similar. On the other hand, in the familiar *H. catenularia* of the same formation, the corallum consists of large corallites separated by the intervention of small closely tabulate tubes." An examination of the structure of Canadian specimens reveals the fact that in different specimens the small closely tabulate tubes or tubules described by Nicholson are not constant in their proportionate size to the corallites and differ in size from those which are wider than the corallites themselves to those which have a scarcely appreciable width, making a gradual transition to the forms in which the tubules appear to be obsolete. In a specimen from l'Anse au Gascon, Baie des Chaleurs (Lower Helderberg) the tubules sometimes exceed the corallites in width and are furnished with very close set tabulae which have an almost vesicular appearance on account of the introduction of secondary tabulae; the tabulae are depressed in the centre and are bent downward at their edges. In the Niagara formation in Ontario examples occur in which the tubules are slightly less than one half the width of the corallites, but the majority of the specimens from this formation in Ontario, at Lake

7 mm. by .45 mm. in size; specimens with corallites of quadrangular in transverse different specimens, that are narrowly oval and circular, only occur in the same species principally on as seen in horizontal section; reasons for still considering it *Halysites*, at least as a variety

ward appearance between the classification upon this table, one passes on to an varieties arising from transition has adopted a classification of the inter to two groups; in one he are found apparently continuous space of variable width of Paleontology," 3rd ed. species of *Halysites* may corallum is composed through of corallites of different an rocks is an example of On the other hand, in the , the corallum consists of of small closely tabulate Canadian specimens reveals closely tabulate tubes or at in their proportionate which are wider than the scarcely appreciable width, which the tubules appear to Gascon, Baie des Chaleurs and the corallites in width which have an almost vesicular of secondary tabulae; the downward at their edges. les occur in which the of the corallites, but the on in Ontario, at Lake

Temiscaming, at Cross Lake Rapids on the Saskatchewan River and at Cedar Lake, and from rocks of nearly if not the same age in Anticosti, the tubules are from $\frac{1}{4}$ to $\frac{1}{2}$ the width of the corallites.

Particular stress has been laid on the presence or absence of septal spines by Dr. Nicholson. In his "Palaeozoic Tabulate corals," p. 229, it is stated that "the form known as *H. escharoides*, Lam., is distinguished from the typical *H. catenularia*, Linn., not only by the superficial characters just mentioned,* but also by the constant possession of spiniform septa, and the apparently constant absence of small tubes between the large ones." This is not borne out, however, by Canadian specimens. An example from the Niagara limestone of Ontario has tubules between the corallites admirably shown as well as rows of septal spines; other examples with tubules and septal spines have been collected at Lake Temiscaming (Niagara), at Cross Lake Rapids on the Saskatchewan River and at Cedar Lake (Niagara) and from the Lower Helderberg rocks of l'Anse-au-Gascon, l'Anse à la Barbe, &c., Baie des Chaleurs. When the tubules are present and the septal spines are not seen, it is possible that the latter, on account of their small size, have not been preserved or are not sufficiently distinct to be recognized.

The gradation of one form of *H. catenularia* into another would lead to the belief that it consists of one typical form with several stratigraphical varieties; the typical form not being the oldest.

It is found however that the *Halysites* of different geological horizons have distinctive characteristics which are apparently constant. This is important as affording a guide to the determination of the relative ages of the earlier Palaeozoic rocks in this country, and as placing a value on the occurrence of *Halysites* in these rocks far greater than it has hitherto had.

Taking *H. catenularia*, L., as the type of the species and regarding the coral as found in rocks of Niagara age, and distinctive of that formation in Canada, as its equivalent in this country, it is the opinion of the writer that the divergent forms, whilst sufficiently distinct for varietal differentiation, would scarcely admit of specific separation: they are here regarded as varieties yet distinctive of definite horizons.

A table,† for comparative use, has been prepared from data obtained from Canadian specimens, the property of the Geological Survey, giving measurements of the corallites and tubules, the shape and distance apart of the tubulae, and stating whether septal spines have been observed or not, with the name of the collector, date of collection and formation

* The size of the tubes (corallites) and the dimensions of the meshes of the corallum.

† Page 74.

from which the specimens were obtained. From this table it can be seen that *H. catenularia* and its varieties range from the Black River limestone at the base of the Trenton formation up to the rocks of the Lower Helderberg group; and that the Black River limestone in eastern Canada, the Galena-Trenton of the Lake Winnipeg region, &c., in the west, the Hudson River, Niagara, &c., in the east, and the Helderberg formations have their distinctive varieties.

Mr. Whiteaves has drawn my attention to the fact that the chain coral was collected (probably for the first time in North America) at Drummond Island, Lake Huron, by Dr. J. J. Bigsby, in 1819 or 1820 (see p. 204 of the first volume of the second series of the Transactions of the Geological Society of London, in 1824). Also that the next mention of *Halysites* as occurring in Canada, if not in America, was made by William Henry Fitton, M.D., F.R.S., G.S., &c., on p. 559 of appendix No. 4 to the "Narrative of the Arctic Land Expedition to the mouth of the Great Fish River, and along the shores of the Arctic Ocean, in the years 1833, 34 and 35, by Capt. Back, R.N., London, 1836." In reference to the limestone fossils brought by Capt. Back, from Lake Winnipeg, Dr. Fitton says: "There is also one specimen which, though not in good preservation, is doubtless a *Catenipora* or chain-coral," The exact locality is not given, but the fossil is in all probability the same as one of the forms from Lake Winnipeg or vicinity mentioned in the table accompanying this paper.

HALYSITES CATENULARIA, L.

Plate III., figs. 1, 1a, 1b, 2, 2a and 3, 3a.

The typical form as identified by United States and Canadian palaeontologists under this name, or that of *Catenipora escharoides*, Lam., and *C. agglomerata*, Hall.

The most typical form of the chain coral, in the writer's judgment, occurs in the Niagara formation of Ontario, at and near Owen Sound, on Cockburn Island, and at Lake Temiscaming; near the mouth of the Saskatchewan River; and in rocks of nearly if not the same age in Anticosti and near Donald, B.C.

The specimens show a considerable variation in the size of the meshes, within certain limits, as can be seen from the table of measurements; tubules are present between the corallites, averaging about .5 mm. in width, and having close set, almost at times vesicular, strongly arched tabulae; septal spines are well preserved in some specimens, in others they are only indicated and at times not preserved.

Specimens have been collected from the Guelph formation which are possibly referable to the typical form; they are described in the char-

From this table it can be seen that the Black River formation is older than the rocks of the River limestone in eastern Wisconsin, and the western Wisconsin region, &c., in the western part of the Helderberg formation.

to the fact that the chain of mountains in North America) at the time of J. Bigsby, in 1819 on the second series of the Helderberg formation in Canada, if not in the M.D., F.R.S., G.S., &c., on the coast of the Arctic Land Expedition, along the shores of the Hudson Bay, by Capt. Back, R.N., who brought by Capt. Back, R.N., fossils brought by Capt. Back, R.N., "There is also one observation, is doubtless a locality is not given, but of the forms from Lake Huron, accompanying this paper.

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and 3, 3a.

Canadian paleontologists under the name of *agglomerata*, Hall.

and the writer's judgment, and near Owen Sound, on the north shore of the lake near the mouth of the St. Lawrence, not the same age as Anti-

the size of the meshes, table of measurements; ranging about .5 mm. in diameter, strongly arched specimens, in others

or on which are observed in the char-

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CANADIAN PALEOZOIC CORALS.

characteristic yellow dolomite, and do not show any very minute details of structure; there are indications of spiniform septa, but tubules so far have not been recognized with any degree of certainty, although there are evidences of what might be tubules with rather arched tabulae. Mr. Whiteaves records the occurrence of *H. catenularia* in the Guelph formation of Ontario (vide Pal. Foss. vol. III., pt. II., p. 47), at Guelph, collected by E. Billings, 1857; at Elora, R. Bell, 1861; at Hespler, T.C. Weston, 1867; and at Durham, J. Townsend, 1878—82.

HALYSITES CATENULARIA, var. *QUEBECENSIS*. (Var. nov.)

Plate IV., figs. 1, 1a, 1b.

In the Geology of Canada, 1863, p. 165, Billings mentions the occurrence of *H. catenularia* at Lake St. John, Que. Speaking of the lower Silurian strata exposed between the mouth of the Metabetchouan River and Blue Point, he says, "the lower rocks of the series are limestones, and their fossils indicate that they belong to the Birdseye and Black River and Trenton formations." The chief part of the limestones are of a yellowish-grey, and at the Ouiaichouan in a three foot bed of this description at the base of the series there was met with *Halysites catenularia*, in no other place found so low on the American continent." The specimens from this locality bear a strong resemblance in outward form to *H. escharoides*, Lam., as figured by Goldfuss in the *Petrefacta Germanica*, vol. 1, figs. 4a, 4b, 4c. In most of the specimens the inner structure is difficult to make out, but in one specimen in particular remarkably narrow tubules are observed. The corallites are oval and the tabulae rather flat and not very close together. This variety can be recognized by its general form, growth with small meshes and rather small corallites, and by the presence of very narrow tubules with rather distant, flat tabulae. Some of the most perfect specimens are hemispherical in shape and attain a breadth of 6 to 8 inches.

HALYSITES CATENULARIA, var. *GRACILIS*, Hall.

Plate III., figs. 5, 5a, 5b, 6 and 7.

Catenipora gracilis, Hall. 1851. Geol. Lake Superior Land Dist., vol. 2, p. 212, pl. XXIX., fig. 1a, 1b.

This form is distinctive of the Galena-Trenton, as it occurs at Lake Winnipeg and further north, and of the Hudson River formation in Anticosti and the province of Ontario. Hall described this form in 1851 as a distinct species under the name *H. gracilis*. The rocks of Hudson River age at Green Bay, Wisconsin, from which the specimen described

by Hall (op. cit.) was obtained are seen further to the east in the Manitoulin Islands. The original description is as follows—"Coral massive, or hemispheric; cells quadrangular or sub-oval; walls thin; interspaces rarely thicker than the walls; arranged in a single series, in wide irregular reticulations. This species differs from the *C. escharoides* in the almost quadrangular form of the cells and the extremely thin walls, the reticulations are wider and the whole aspect less solid than in that species. From *C. agglomerata*, it differs essentially in the form and arrangement of the cells." "Eastern shore of Green Bay, Wisconsin." What is particularly noticeable in this variety is the marked angularity of the corallites, their sides being flattened, and the apparent absence of tubules between them. The longitudinal rows of septal spines are beautifully preserved in some specimens, especially in a few from East Selkirk, Manitoba. The variability of the size of the meshes is again seen in this variety, showing that something apart from the mere shape of the corallum is necessary for differential use.

HALYSITES CATENULARIA, var. MICROPORA, Whitfield.

Plate III., fig. 4.

Halysites catenulatus, var. *microporus*, Whitfield, 1882. Geol. of Wisconsin, vol. IV., p. 272, pl. XIII., fig. 6.

In the Niagara formation of Ontario specimens are met with that have very small corallites. These are similar to the specimen, already mentioned, from near Donald, B.C. (Silurian) and one from the Jumpers, Anticosti (Silurian). In most of the specimens seen the meshes are rather small, but in some they are comparatively large and irregular. In none, however, was the inside structure seen by means of sections, so that the writer is unable to state whether tubules are present or not, nor could this be decided from the fossils when examined at the surface.

This form appears to be similar to *H. catenularia*, var. *micropora*, Whitfield, from the Niagara group of Wisconsin; its corallites are of about the same size, nearly twenty occurring in the space of 1 inch.

Pending further knowledge of the details of its structure, this small form is, for the present, referred to the Wisconsin variety.

HALYSITES CATENULARIA, var. SIMPLEX. (Var. nov.)

Plate IV., figs. 3, 3a.

The principal characteristics of this variety are, the large size of its corallites, its long narrow meshes and the absence of tubules. A single

her to the east in the Manitowish as follows—"Coral massive, al; walls thin; interspaces single series, in wide irregular *C. escharoides* in the almost nely thin walls, the reticula-solid than in that species. the form and arrangement on Bay, Wisconsin." What the marked angularity of the apparent absence of tubules septal spines are beautifully w from East Selkirk, Manitowish is again seen in this the mere shape of the coral-

OPORA, Whitfield.

Geol. of Wisconsin, vol. IV., p. fig. 6.

imens are met with that r to the specimen, already rian) and one from the the specimens seen the re comparatively large and tructure seen by means of hether tubules are present sils when examined at the

enularia, var. *micropora*, ; its corallites are of about ace of 1 inch.

of its structure, this small in variety.

X. (Var. nov.)

are, the large size of its nce of tubules. A single

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specimen was obtained from rocks of Lower Helderberg age, near the mouth of the Little Cascapedia River, Que.; it is preserved in limestone and there is no evidence of tubules being present; what appear to be septal spines are indistinctly seen.

HALYSITES CATENULARIA, var. *AMPLITUBULATA*. (Var. nov.)

Plate IV., figs. 4, 4a.

This might rightly be considered the most striking of the varieties of this species; in it the tubules are found to be as large as and even larger than the corallites themselves. It occurs in the Lower Helderberg rocks of l'Anse à la Barbe and l'Anse au Gascon, Que. Only portions of different coralla were collected, so that it is difficult to make out exactly its general form of growth, although it appears to be rather spreading. The details of structure are stated in the accompanying table and the figures will give an idea of the great development of the tubules. Septa have not been seen. The tubule of the tubules are noticeably coalescent; they are close set, concave at the centre and ab. aptly bent down at the edges. The corallites are almost circular and their tubule are comparatively regular and distant.

HALYSITES CATENULARIA, var. *NITIDA*. (Var. nov.)

Plate IV., figs. 2a, 2b.

A number of specimens, sometimes in masses 6 inches and more across, from the Lower Helderberg rocks found at l'Anse à la Barbe and vicinity, Baie des Chaleurs and Neigette Falls, near Rimouski, Que., represent this variety in the collection. The meshes made by the corallites are small; the corallites themselves are small, oval in section and separated by moderately narrow tubules; in longitudinal sections the compactness and regularity of the tabulation of both the corallites and tubules is noticeable. Septal spines are present.

HALYSITES COMPACTA, Rominger.

Plate IV., figs. 5, 5a, 6, 7 and 8, 8a.

Halysites compactus, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 78, plate XXIX., fig. 3.

" " Whiteaves. 1884. *Palmos. Foss.*, vol. III., pt. I., p. 2.

Halysites agglomeratus var. *compactus*, Whiteaves. 1895. *Ibid.*, vol. III., pt. II., p. 48.

This species is thus defined in Dr. Rominger's work on corals: "Tubes * oval, in chain-like, lateral conjunction, but these laminae are so closely approximated, that no retiform loops are formed by them; they come in contiguity with each other from all sides, and leave only small, angular, lacunose interstices in the corners of their intersection, which are not larger than the tube orifices themselves. By this close approximation of the tubes on all sides many of them become pressed into a polygonal form and resemble a *Favosites*, from which they differ, however, in the absence of lateral pores. The diaphragms of the tubes are closely approximated, flat, concave or convex in the same specimens. Their diameter is about one and a half millimeter. Found in the Niagara group along the outcrops of the Upper Peninsula, at the shore of Lake Michigan. In a stratum of an outcrop at the mouth of Manistique River this species is quite common."

Halysites compacta occurs in Canada, as far as is now known, in the Niagara formation at Lake Temiscaming, Ont., in the Guelph formation at Gait, Elora and Hespeler, Ont., and near Donald, B.C., in rocks of Silurian age. The Guelph specimens in the collection of the survey were seen by Dr. Rominger, who testified to the correctness of Mr. Whiteaves's identification (vide op. cit. p. 2). Dr. Robert Bell in 1887 obtained three specimens from Lake Temiscaming, one of which (Plate IV., fig. 5) is identical with the type as figured by Rominger, and agrees at all points with the specific description. Another (Plate IV., fig. 6) shows a slight variation in that the corallites are not always in contact, there being interspaces which are at times slightly larger than the corallites. The third is similar to a number of specimens collected in 1893 and 1894 by Mr. A. E. Barlow, of this Survey, also at Lake Temiscaming, at a locality about two miles distant from where Dr. Bell collected his, which although belonging most probably to Dr. Rominger's species, still depart from this typical form in so decided a manner as to be worthy of notice. A single specimen was also collected in 1885, by Prof. A. P. Coleman, on the N. E. side of the Columbia River, near Donald, B.C., from rocks of Silurian age, and another was obtained by J. B. Tyrrell, in 1890, in rocks of the same age at the foot of Grand Rapids, near the mouth of the Saskatchewan River.

If we imagine a specimen of *H. catenularia*, L., with the corallites brought so close together as to be in actual contact, and to have the meshes so far reduced in size as only to be represented by small, generally triangular, spaces at intervals round the corallites, then we have a typical specimen of *H. compacta*, Rominger.

* The word "tube" used by Dr. Rominger, has reference to the corallites, and not to the tubules between the corallites.

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corallites, then we have a

to the corallites, and not to

The specimens brought by Mr. Barlow from Lake Temiscaming differ in the following respects from the first mentioned form, viz., the corallites are smaller, circular instead of being hexagonal in shape, and the interspaces instead of being triangular are roughly oval or circular and reduced in size: generally six are seen surrounding a single corallite. Longitudinal sections reveal the presence of tubules, from $\frac{1}{2}$ to $\frac{1}{3}$ the width of the corallites, with close set, narrowly arched tabulae, about twenty of which are found in a space of 5 mm. The tabulae of the corallites are flat or concave and there are from fourteen to eighteen in 5 mm. In some of the specimens the spiniform septa, twelve in number, are beautifully preserved (Plate IV., figs. 8, 8a). The corallites in this form are further apart on account of their walls being proportionately thicker and it is difficult to discern the difference between the tubules proper and what now represent the interspaces greatly reduced in size. In fact, Mr. Barlow's specimens might readily at first sight be mistaken for a form of *Heliolites* with very few "small corallites" between the larger ones.

Prof. Coleman's fossil (Plate IV., fig. 7) agrees in the arrangement of the corallites and interspaces with Rominger's figure and Dr. Bell's first

Species and variety.	Locality.	Formation.	Shape and average size of trilobites	Average width of trilobites.
<i>H. catenularia</i> , var. <i>Quebecensis</i> .	1 Lake St. John, Q. Blue Point and vicinity.	Black River limestone.	Oval. Length. 1.25 mm. Breadth. 1.00 "	0.2
	2 East Selkirk and various localities, Lake Winnipeg.	Galena-Trenton.	Oval to somewhat quadrangular. Length. 1.85 mm. Breadth. 1.25 "	Not seen.
<i>H. catenularia</i> , var. <i>gracilis</i> , Hall.	3 Jack Head Island, Lake Winnipeg.	Galena-Trenton.	Quadrangular. Length. 2.25 mm. Breadth. 2.00 "	Not seen.
	4 Nelson River, 2nd and 3rd Limestone Rapids.	Galena-Trenton.	Quadrangular. Length. 1.75 mm. Breadth. 1.25 "	Not seen.
	5 North of Grand Rapids, Saskatchewan R. (Station No. 102.)	Galena-Trenton.	Oval to somewhat quadrangular. Length. 1.50 mm. Breadth. 1.00 "	Not recognizable.
	6 Churchill Harbour, Hudson Bay.	Galena-Trenton?	Quadrangular. Length. 1.10 mm. Breadth. 0.95 "	Not seen.
	7 West End Camp, Anticosti, Que.	Hudson River.	Somewhat quadrangular. Length. 1.50 mm. Breadth. 1.00 "	Not satisfactory seen.
	8 Gamache Bay, Anticosti.	Anticosti Gr. Division 1. (Silurian.)	Rather broadly oval. Length. 1.50 mm. Breadth. 1.00 "	Not satisfactory seen.
	9 Wall's Cove, Anticosti.	Anticosti Gr. Division 2. (Silurian.)		
	10 Jumpers, Anticosti	Anticosti Gr. Division 4 (Silurian.)	Oval. Length. 2.00 mm. Breadth. 1.50 "	0.5
	11 Lake Temiscaming	Niagara	Broadly oval to circular. Length. 1.75 mm. Breadth. 1.50 "	0.5
	12 Lake Temiscaming	Niagara	Oval. Length. 2.50 mm. Breadth. 2.00 "	0.5
<i>H. catenularia</i> , L.	13 Lake Temiscaming	Niagara	Narrowly oval. Length. 1.00 mm. Breadth. 0.50 "	Not seen.
	14 Owen Sound and Huronia Point, Cookburn Island.	Niagara	Oval and rather narrowly oval. Length. 2.75 mm. Breadth. 2.00 "	0.75 In some specimens 0.5

Shape and average size of corallites	Average width of tubules.	Average size of meshes.	Whether with septal spines or not.	Tabulae of corallites.	Tabulae of tubules.	Collector. Date.
Oval. Length. 1.25 mm. Breadth. 1.00 "	0.2	rather small, about 4 mm. wide.	None seen....	Straight or slightly concave, about 10 in 5 mm.	Straight, about 10 in 5 mm.	J. Richardson, '57. W. McOnat & Jno. Leitch, 1871.
Oval to somewhat quadrangular. Length. 1.85 mm. Breadth. 1.25 "	Not seen.	Large and irregular, often narrow and long, when somewhat circular 9 mm. wide.	In East Selkirk specimens beautifully preserved, in Lake Winnipeg specimens sometimes preserved.	Generally flat, sometimes slightly concave or convex, 6 to 9 in 5 mm.	—	T. C. Weston, 1884. J. B. Tyrrell, 1889. D. B. Dowling, 1890, 1891. L. M. Lambe, 1890. Dowling & Lambe, 1890.
Quadrangular..... Length. 2.25 mm. Breadth. 2.00 "	Not seen.	Very irregular in size, 8 mm. across when moderately circular.	Not seen.....	Flat, 8 in 5 mm. on an average.	—	D. B. Dowling and L. M. Lambe, 1890.
Quadrangular..... Length. 1.75 mm. Breadth. 1.25 "	Not seen.	mm. across.....	Present.....	Slightly concave or flat, 8 to 10 in 5 mm.	—	R. Bell, 1879.
Oval to somewhat quadrangular. Length. 1.50 mm. Breadth. 1.00 "	Not recognizable.	about 6 mm. across on an average.	Beautifully preserved.	Flat, slightly concave or convex, 8 in 5 mm.	—	J. B. Tyrrell, 1890.
Quadrangular..... Length. 1.10 mm. Breadth. 0.95 "	Not seen.	Very small, from 1 to 2 mm. wide.	Not seen.....	Straight, 10 in 5 mm.	—	J. B. Tyrrell, 1894.
Somewhat quadrangular. Length. 1.50 mm. Breadth. 1.00 "	Not seen.	mm. across.....	Indicated....	Flat or slightly concave, 8 in 5 mm. on an average.	—	J. Richardson, '56.
rather broadly oval. Length. 1.50 mm. Breadth. 1.00 "	Not satisfactory seen.	About 6 mm. wide.	Indicated....	Flat, often slightly concave. Frequently with secondary tabulae, 14 in 5 mm.	—	J. Richardson, '56.
oval..... Length. 2.00 mm. Breadth. 1.50 "	0.5	mm. in width....	Not seen.....	Straight or slightly concave, about 8 to 12 in 5 mm.	Straight or convex, 16 to 20 in 5 mm.	J. Richardson, '56.
readily oval to circular. Length. 1.75 mm. Breadth. 1.50 "	0.5	Varying from about 4 by 4 mm. and even smaller to 55 by 7 mm.	Indicated....	Generally straight, often concave, sometimes convex, about 10 in 5 mm.	Very strongly convex, 18 or 20 in 5 mm.	R. Bell, 1887. A. E. Barlow, 1893, 1894.
oval..... Length. 2.50 mm. Breadth. 2.00 "	0.5	Large and spreading.	Not seen.....	Same as in No. 8.	No. 8.	A. E. Barlow, 1893, 1894.
narrowly oval..... Length. 1.00 mm. Breadth. 0.50 "	Not seen.	Very variable in size. From 3 by 3 mm. to 15 by 4 mm.	Not seen.....	Generally flat, about 16 in 5 mm.	—	A. E. Barlow, 1893, 1894.
Same as No. 10, except that	10, except that	at the tubules are	apparently wanting.			R. Bell, 1887. A. E. Barlow, 1893, 1894.
al and rather narrowly oval. Length. 2.75 mm. Breadth. 2.00 "	0.75 In some specimens 0.5	21 mm. across.....	Not seen.....	Flat, about 6 in 5 mm.	Flat, about 12 in 5 mm.	R. Bell, 1886. J. Townsend, 1882.

Species and variety.	Locality.	Formation.	Shape and average size of corallites.	Average width of tubules.
<i>H. catenularia</i> , var. <i>micropora</i> , Whitfield.	15 Derby township, nr. Owen Sound, Ont.	Niagara.....	Circular or oval. L. 1.50 to 2.00 mm. Breadth 1.50 "	Silicified specimens, structure obscure, tubules not seen. 0.75
	16 Derby township, nr. Owen Sound, Ont.	Niagara.....	Broadly oval to circular. Diameter 1.25 mm.	0.40
	17 Cross Lake Rapids, Saskatchewan R. and Cedar Lake.	Niagara.....	Oval to circular. From 3 by 2 mm. to 1.5 by 1 mm.	Not seen...
	18 NE side Columbia River, B.C. near Donald.	Upper Silurian	Broadly oval. Length. 2.50 mm. Breadth 2.00 "	Not seen...
	19 NE side Columbia River, B.C. near Donald.	Upper Silurian	Oval. Length .0.70 mm. Breadth 0.45 "	Not seen...
	20 Hespler, Ont.	Guelph.....	Oval. From 1.50 by 1.00 to 3.50 by 2.50 mm. in different specimens.	Not recognizable.
<i>H. catenularia</i> , var., <i>simplex</i> .	21 One mile east of Little Cascade River, Que.	Lower Helderberg.	Oval. Length. 4.00 mm. Breadth. 2.5 "	Not present.
<i>H. catenularia</i> , var., <i>amplitubulata</i> .	22 L'Anse à la Barbe, l'Anse au Gascon, Que.	Lower Helderberg.	Broadly oval. L. 2.5 to 2.00 mm. Breadth. 1.75 "	2.0 to 2.25
<i>H. catenularia</i> , var., <i>nitida</i> .	23 L'Anse à la Barbe, l'Anse au Gascon, l'Anse aux Bouleaux & l'Anse à la Vieille, Que.	Lower Helderberg.	Oval. Length. 1.45 mm. Breadth. 1.00 "	0.50
	24 Neigette Falls, Q.	Lower Helderberg?	Same as No. 23.	

Shape and average size of corallites.	Average width of tubules.	Average size of meshes.	Whether with septal spines or not.	Tabulae of corallites.	Tabulae of tubules.	Collector. Date.
Circular or oval Length 1.50 to 2.00 mm. Breadth 1.50 "	Silicified specimens with structure obscure, tubules not seen. 0.75	different specimens from 3 mm. to 7 mm. across with some long irregular meshes.	Not seen.....	Flat, 8 to 12 in 5 mm.	—	J. Townsend, 1883.
Broadly oval to circular. Diameter 1.25 mm.	0.75	generally long and narrow, width from 2 to 3 mm.	Septal spines well preserved.	Concave, about 8 in 5 mm.	Convex, vesicular in places, about 20 in 5 mm.	R. Bell, 1859. J. Townsend, 1883.
Oval to circular. From 3 by 2 mm. to 1.5 by 1 mm.	0.40	broad and spreading.	Indicated	Generally flat, often slightly concave or convex, about 8 in 5 mm.	Very convex and close set, 24 in 5 mm.	J. B. Tyrrell, 1890.
Broadly oval. Length 2.50 mm. Breadth 2.00 "	Not seen.....	about 8 mm. across	Not seen.....	Generally flat, about 8 in 5 mm.	—	Prof. A. P. Coleman, 1885.
Oval. Length 0.70 mm. Breadth 0.45 "	Not seen.....	rather irregular. About 5 mm. across.	Internal	structure not preserved.	—	Prof. A. P. Coleman, 1885.
Oval. From 1.50 by 1.00 to 3.50 by 2.50 mm. in different specimens.	Not recognizable.	parallel rows about 6 mm. apart in other specimens large and spreading, some of the expansions as broad as 11 cent.	Indications of septa.	In small form 8 in 5 mm. slightly concave in large form 4 or 5 in 5 mm. concave.	—	I. C. Weston, 1867.
Oval. Length 4.00 mm. Breadth 2.5 "	Not present	meshes very long and narrow; corallites in parallel lines.	Not seen.....	Flat or slightly concave, 6 in 5 mm.	—	R. W. Ellis, 1888.
Broadly oval. Length 2.5 to 2.00 mm. Breadth 1.75 "	2.0 to 2.25	Not seen.....	Flat also slightly convex or concave, 6 in 5 mm.	Slightly concave, abruptly bent down at the edges, 20 in 5 mm.	R. Bell, 1862.
Oval. Length 1.45 mm. Breadth 1.00 "	0.50	Long and narrow; corallites often in parallel rows. Meshes from 5 to 3 mm. across.	Present	Flat or slightly convex, 10 to 20 in 5 mm.	Straight or slightly convex, vesicular at times, 20 in 5 mm.	Logan, 1849. R. Bell, 1862. J. Richardson.
Same as No. 23.						T. C. Weston, 1880.

mentioned Lake Temiscaming specimen. The corallites are hexagonal about 2 mm. in diameter, and the interspaces triangular. In this specimen the coral is well shown on a weathered surface, but below the surface the structure is not sufficiently preserved to reveal anything in longitudinal or transverse sections.

The Guelph representatives of this species have corallites about slightly over 2.5 mm. in diameter, and the interspaces are generally rather irregular in shape and as a rule narrower than the corallites, although their length is sometimes as much as the breadth of two corallites, thus showing a tendency to form true meshes and to depart from the typical growth of *H. compacta* in which no meshes are formed and the corallites touch each other on every side. The corallites are circular in section and have rather thick walls. The specimens available for study are preserved in a light yellow dolomite which does not admit of much detail of structure being made out: the presence of septal spines is indicated but no tubules between the corallites have been detected. The tabulae of the corallites are flat or concave and occasionally convex from five to seven occur in a space of 5 mm. It will be thus seen that *H. compacta* as found in the Guelph formation of Ontario is much coarser or more robust than those forms found in the Niagara formation at Lake Temiscaming, Ont.

Mr. Whiteaves records the collection of this species at Galt, Ont., by the Rev. A. Bell, 1846-50; at Elora, Ont., by Dr. R. Bell, 1861 and D. Boyle, 1883; and at Hespeler, O., by T. C. Weston, 1867. There is in the survey collection a specimen from Durham, Ont., collected by J. Townsend in 1883.

The corallites are hexagonal or triangular. In this species the surface, but below the surface, to reveal anything in longitudinal

ies have corallites about 0.5 mm. interspaces are generally narrower than the corallites, as the breadth of two corallites meshes and to depart from no meshes are formed and The corallites are circular. The specimens available for the which does not admit of the presence of septal spines. Corallites have been detected and occasionally convex. It will be thus seen that H. Ontario is much coarser or Niagara formation at Lake

species at Galt, Ont., by Dr. R. Bell, 1861 and D. Weston, 1867. There is Ham, Ont., collected by J.

HELIOPORIDÆ.

Genus HELIOLITES, Dana, 1846.

(Wilkes's Expl. Exped. Zooph., p. 541.)

Corallum discoidal, hemispherical or pyriform, sometimes in explanate masses, at times ramose, composed of parallel, more or less distant, cylindrical corallites that emerge at right angles to the surface in generally slightly exsert calyces; spaces between the corallites filled with numerous, intimately united, polygonal tubules parallel to the corallites and of the same length; walls of the tubules thin, regular; septa twelve in number, of equal size, sometimes reaching the centre of the visceral chamber, not present in the tubules; tabulæ numerous, horizontal, regular, occurring both in the corallites and tubules; epitheca covering the base.

HELIOLITES INTERSTINCTA, L. (Sp.)

Plate II., figs. 6, 6a.

Andrepore interstincta, Linné. 1767. Syst. Nat., éd. 12, p. 1276.

Helicites interstincta, Milne-Edwards and Haime. 1851. Polyp. Foss. des Terr. Paléoz., p. 214.

" " Milne-Edwards and Haime. 1855. Brit. Foss. Corals, p. 249, pl. LVII., figs. 5, 5a-d.

" " Nicholson. 1875. Palæon. of Ont., p. 51.

Helicites interstinctus, Roninger. 1876. Geol. Sur. Mich., Foss. Corals, p. 11., pl. I., fig. 1.

Helicites interstincta, Nicholson. 1880. Sil. Foss. of Girvan, pp. 57 and 254, pl. XVI., figs. 1-4.

Corallum generally irregularly hemispherical or discoidal with a more or less convex upper surface, attached by the centre of the basal surface, which usually exhibits concentric foldings or ridges of growth and is protected by an apical covering; attaining a diameter of nearly 7 inches with a height of about 3 inches. In its initial stages the corallum is of a pyriform or subspherical shape. Corallites proceeding radially from the basal beginning and issuing at right angles to the surface; they are from 1 to 3 mm. apart, circular, averaging 1.5 mm. in diameter and showing little variation in size in the same specimen. The spaces between the corallites are occupied by numerous polygonal tubules, parallel to the corallites, from .25 to .33 mm. in diameter in different specimens, there being from three to twelve tubules in a straight line between adjacent corallites. The horizontal tabulæ of the corallites are rather regular in disposition, from three to four occurring in a space of 1 mm. The tubules have tabulæ similar to those of the coral-

lites and at very regular intervals apart but closer together, about occurring in a space of 1 mm. In transverse sections the corallites exhibit twelve, delicate, sharply pointed septa of equal size, but whether they are in the form of longitudinal ridges, septal spines or spinulose carinae has not been determined from the specimens available for study. The tubules are devoid of septa. The edges of the calyces are slightly elevated above the general surface of the corallum.

Occurs in the Niagara formation and Lower Helderberg group; specimens from the Lower Helderberg in the collection are from l'Anse à la Vieille, Baie des Chaleurs; from west of l'Anse à la Barbe, Baie des Chaleurs, W. E. Logan, 1843, (identified by E. Billings); from Pointe aux Bouleaux, Baie des Chaleurs, W. E. Logan, 1843, and l'Anse au Gascon, Baie des Chaleurs, R. Bell, 1862; from the Niagara there is one specimen from Assiginack township, Grand Manitoulin Island, Manitouaning Bay at "Fossil Hill," J. Townsend, 1883.

HELIOLITES SUBTUBULATA, McCoy. (Sp.)

Plate II. figs. 7, 7a.

- Palaeopora interstincta*, var. *subtubulata*, McCoy, 1851. Brit. Palaeoz. Fossils, p. 16, pl. I, C, figs. 2, 2a, 2b.
Heliolites Murchisoni, Milne-Edwards and Haime, 1851. Polyp. Foss. des Terr. Palaeoz., p. 215.
 " " Milne-Edwards and Haime, 1855. Brit. Foss. Corals, p. 250, pl. LVII., figs. 6a, 6—c.
Heliolites microporus, Eichwald. 1860. Letheæ Rossica, p. 464, pl. XXV., figs. 7a, 7b, 7c.
Heliolites subtubulatus, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 12, pl. I, fig. 4.

Corallum in the form of explanate masses of irregular shape and varying thickness, sometimes becoming somewhat hemispherical or pear-shaped; at times reaching a considerable size, 5 or 6 inches broad and from 1 or 2 to 4 inches thick or high. Lower surface apparently covered by a thin epitheca. Corallites parallel to each other and at right angles to the surface, circular, averaging .75 mm. in diameter, and varying in different specimens from slightly under .75 mm. to 1 mm.; they are distant from each other from 1, or even less, to 2 mm. The interstitial tubules are polygonal, from three to eight in a straight line between neighbouring corallites. Twelve septa of equal size nearly reach the centre of the corallites. Horizontal tabulae occur in the corallites and tubules at rather regular intervals, those of the former being farther apart than those of the latter; in the corallites there are three or four in a space of 1 mm. and in the tubules five or six in the same distance. The calyces

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of equal size, but whether
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Anse à la Barbe, Baie de
Billings); from Pointe
443, and l'Anse au Gascon
Niagara there is one specimen
Island, Manitouaning Bay.

slightly exsert, their edges appearing at the surface as well marked
a little above the level of the intervening tubular areas. This
species is distinguished from others of the genus by its small and rather
stant corallites.

H. subtubulata occurs in the Niagara formation and the Lower Hel-
derberg group; in the Niagara at the north end of Lake Temiscaming,
Que., collected by R. Bell, 1887, and at "The Jumpers," division IV.,
Anticosti Group, Anticosti, J. Richardson, 1856; in the Lower Helder-
berg at l'Anse à la Barbe, Baie des Chaleurs, W. E. Logan, 1843; west
of l'Anse à la Barbe, J. Richardson; at l'Anse à la Vieille, Baie des
Chaleurs, J. Richardson, and at the same locality, R. Bell, 1862. A
poorly preserved specimen from the Niagara of Owen Sound, Ont., col-
lected by J. Townsend in 1874, appears to belong to this species.
Rominger records the occurrence of this species in the Niagara of Point
Detour and Drummond Island, Lake Huron.

Coy. (Sp.)

HELIOLITES INORDINATA, Lonsdale. (Sp.)

Brit. Palaeon. Fossils, p. 16, pl.

51. Polyp. Foss. des Terr.

Brit. Foss. Corals, p. 280.

p. 454, pl. XXV., figs. 7a.

ich., Foss. Corals, p. 12, pl.

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Porites inordinata, Lonsdale. 1839. In Murchison, Silur. Syst., p. 687, pl. 16 bis,
figs. 12, 12 a—c.

Helicites inordinata, Milne-Edwards and Haime. 1851. Polyp. Foss. des Terr. Palaeoz.,
p. 217.

" " Milne-Edwards and Haime. 1855. Brit. Foss. Corals, p. 253,
pl. LVII., figs. 7, 7a.

Corallum ramose or lobate, with branches or lobes circular or oval in
section, from 3 or 4 mm. to nearly 2 cent in diameter, proceeding from a
massive base. The generality of specimens usually consists of fragments
of branches from the upper part of the corallum, but one specimen in the
collection shows that the basal part may be massive, with branches or
lobate processes of considerable thickness springing therefrom. Corallites
circular, about 1.5 mm. in diameter, seldom more than 1 mm. apart, often
much closer, with twelve septa reaching to the centre. Interstitial tubules
polygonal, three or four in a space of 1 mm. In the branches the coral-
lites and tubules diverge from an imaginary central axis, terminating
either at right angles or slightly inclined to the surface, in which latter
case the calyces are rather oval than circular, the lengthening taking place
in the longitudinal direction of the branch. Tubules horizontal, in the
tubules four or five occur in a space of 1 mm., but in the corallites they are
not quite so close set.

H. inordinata is distinguished from other species of the genus principally
by its ramose form.

Lower Helderberg group.—West of l'Anse à la Barbe, Baie des Chaleurs, W. E. Logan, 1843, (identified by E. Billings), l'Anse à la Vieille, Baie des Chaleurs, R. Bell, 1862, and two specimens from l'Anse à la Vieille, probably collected by J. Richardson.

GENUS PLASMOPORA, Milne-Edwards and Haime, 1849.

(Compt. Rend., t. XXIX, p. 262.)

Propora, Milne-Edwards and Haime. 1849. Compt. Rend., t. XXIX., p. 262.

Corallum hemispherical or irregularly massive, with a convex upper surface; corallites long, cylindrical, at right angles to the surface, distant, their interspaces filled with numerous parallel, polygonal tubules defined by distinct walls; tabule of the corallites regular, horizontal, numerous, those of the tubules convex, interfering with the regularity of the walls, septa twelve in number, well developed, sometimes almost obsolete, confined to the corallites.

The chief point of difference between *Heliolites* and this genus is, that whereas, in the former the tubules have regular, well-defined, vertical walls and horizontal tabulæ, similar to those of the corallites but more numerous, in the latter the tubules are filled with convex plates that disturb the orderly arrangement of the walls, causing them to be irregularly zigzag instead of straight in their upward growth.

PLASMOPORA FOLLIS, Milne-Edwards and Haime.

Plate II, figs. 8, 8a.

Plasmopora follis, Milne-Edwards and Haime. 1851. Polyp. Foss. des Terr. Palæoz., p. 223, pl. 16, fig. 8, 8a.
" " Rominger. 1873. Geol. Sur. Mich., Foss. Corals, p. 13, pl. III, fig. 2.

This species is found in the form of large masses, sometimes 6 inches in breadth, of somewhat irregular shape, generally convex above and presumably covered below by an epitheca. Corallites from 1.25 to 1.5 mm. in diameter, circular, distant from .3 to 1 mm. Tubules polygonal, from one to three in the shortest line between neighbouring corallites. Tabulæ are present in the corallites; they are horizontal, from three to five occurring in a space of 1 mm. In longitudinal sections convex tabulæ are seen in the tubules, giving the coenenchymal structure a vesicular appearance, and whereas in transverse sections the polygonal outlines of the tubules are clearly defined, in longitudinal sections the tubular walls appear as zigzag vertical lines, rendered obscure by their amalgamation with the

la Barbe, Baie des Chaleurs,
l'Anse à la Vieille, Baie
from l'Anse à la Vieille

and Haime, 1849.

p. 262.)

tend., t. XXIX., p. 262.

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Foss. Corals, p. 13, pl. III.

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Tubules polygonal, from
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from three to five occur
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a vesicular appearance;
outlines of the tubules
tubular walls appear as
amalgamation with the

downward bent edges of the tabule. Septa apparently represented only
by a slight thickening of the walls of the corallites.

Lower Helderberg group.—L'Anse à la Vieille, Baie des Chaleurs, west
of fault, † J. Richardson, and one mile east of mouth of Little Caspédia
River, Baie des Chaleurs, R. W. Ells, 1883.

PLASMOPORA PETALIFORMIS, Lonsdale. (Sp.)

Plate II., figs. 9, 9a.

Forites petaliformis, Lonsdale. 1839. In Murchison, Silur. Syst., p. 687, pl. 16, figs. 4, 4a.

Plasmopora petaliformis, Milne-Edwards and Haime. 1851. Polyp. Foss. des Terr.
Palæoz., p. 221.

" " Milne-Edwards and Haime. 1855. Brit. Foss. Corals, p. 253,
pl. LIX., figs. 1, 1a—c.

Heliolites sparsus, Billings. 1865. Canadian Naturalist, new series, vol. II., p. 428.

" " Billings. 1866. Cat. Sil. Foss. of Anticosti, p. 81.

Corallites 2 mm. in diameter or slightly under, circular, with twelve
equal lamellar septa, almost extending to the centre; distant from each
other from about 1 to 4 mm. Between the corallites are numerous
irregularly polygonal tubules, rather unequal in size, from four to eight
occurring in a line between adjacent corallites. The tabule of the coral-
lites are horizontal and placed close together from three to five in a
space of 1 mm. The tubules are occupied by more or less convex or con-
cave tabule which interfere with the regularity of the walls of the
tubules; the latter appear in longitudinal sections as parallel, somewhat
irregular lines running in a vertical direction to the surface. The Can-
adian specimens examined have the structure well preserved, but they do
not show the external form; according to Lonsdale and Milne-Edwards
and Haime the corallum is hemispherical.

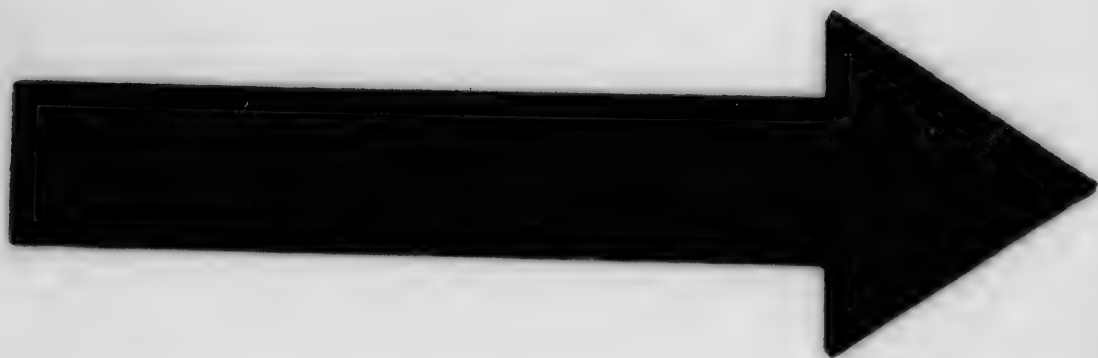
This species differs from *Plasmopora foliis*, Milne-Edwards and Haime
in having larger and more distant corallites, with a larger number of
conenchymal tubules in the interstitial spaces.

Niagara formation and Lower Helderberg group.—Anticosti group,
division IV., Anticosti, two miles west of Chicotte River, J. Richardson,
1856; l'Anse à la Vieille, Baie des Chaleurs, † J. Richardson.

Genus *LYELLIA*, Milne-Edwards and Haime. 1851.

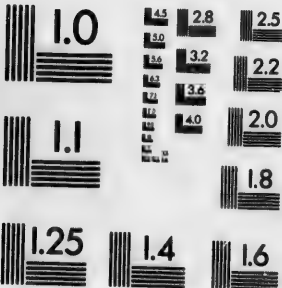
(Polyp. Foss. des Terr. Palæoz., p. 226.)

Corallum massive, of various shapes, globular, pyriform or hemispheri-
cal, sometimes tuberoso or discoidal, also in the form of flabellate or lobate
expansions with calyces on both sides; corallites cylindrical, varying in



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their distance from each other, sometimes touching; interstitial structure vesicular, made up of convex plates, of rather unequal size, resting on each other; septa represented by twelve, spinose, longitudinal raised ridges or carinae that appear at the slightly exserted edges of the calyces as rounded tubercles; intercalicular surface often granular or tuberculous; tabulae of the corallites numerous, horizontal; basal epitheca present.

The genus *Lyellia* differs principally from both *Heliolites* and *Plasmopora* by having vesicular structure between the corallites instead of more or less well defined tubules.

LYELLIA AFFINIS, Billings.

Plate V., figs. 1, 1a.

- Heliolites affinis*, * Billings. 1865. Canadian Naturalist, new series, vol. II., p. 427.
 " " Billings. 1866. Cat. Sil. Foss. of Anticosti, pp. 5 and 30, fig. 12.
Lyellia papillata, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 15, pl. II., fig. 8.

The corallum of this species, as shown by the numerous specimens in the collection of the Geological Survey, and as stated by Billings in his original description, is hemispherical, globular, pyriform, clavato-tubinate or tuberoso; in its earlier stages it is discoidal with a slightly convex upper surface and flat or concave below. The smallest specimen in the collection is about 16 mm. in diameter and 4 mm. thick; it is composed of about fifty-eight corallites, and has the base protected by a concentrically wrinkled epitheca. From larger specimens the corallum is seen to attain a breadth of a little over 4 inches when hemispherical, and a height of 3 to 5 inches when pyriform. Corallites circular, from 1 to 2 mm. in diameter with an average width of about 1.5 mm., touching each other, or at slight distances up to one-half their width apart; sometimes when crowded they become subpolygonal. Interstitial spaces filled with vesicular tissue formed of small, more or less, convex plates. Tabulae of the corallites, horizontal or slightly convex or concave, from two to four in a space of 1 mm. Septa twelve in number, when well preserved, seen to reach about one-quarter of the way to the centre of the corallites. The edges of the calyces, when the surface is not worn, bear twelve rounded tubercles slightly raised above the intercalicular areas.

Occurs in the Hudson River and Niagara formations, in the four divisions of the Anticosti group, and in the Lower Helderberg group. In the

*In the "Fossil Corals of Michigan," 1876, p. 16, Dr. Rominger pointed out that *Heliolites affinis*, Billings, *Heliolites speciosa* Billings, and *Heliolites exigua*, Billings, all belong to the genus *Lyellia*.

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series, vol. II., p. 427.
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Hudson River of the Island of Anticosti, and the divisions of the Anticosti group, at numerous localities, T. C. Weston, 1855 and 1865, J. Richardson, 1856, and J. Macoun, 1883; in the Niagara, at Thorold, Ont., E. Billings, 1857, on the Isle of Mann (Burnt Island), Lake Temiscaming, Que., A. E. Barlow, 1893, at Cross Lake Rapids, Roche Rouge, and Grand Rapids, Saskatchewan River, Sas., J. B. Tyrrell, 1890, (by whom it was identified with *L. papillata*) and at Grand Rapids, D. B. Dowling, 1891; in the Lower Helderberg, at "The Forks" of the Scaumenac River, Que., R. W. Ellis, 1883.

LYELLIA AMERICANA, Milne-Edwards and Haime.

Plate V., figs. 2, 2a.

Lyellia Americana, Milne-Edwards and Haime. 1851. Polyp. Foss. des Terr. Palæoz., p. 226, pl. 14, figs. 3, 3a.

Heliolites speciosus, Billings. 1865. Canadian Naturalist, new series, vol. II., p. 426.

Heliolites speciosus,* Billings. 1866. Cat. Sil. Foss. of Anticosti, p. 30, fig. 13.

Lyellia Americana, Rominger. 1876. Geol. Sur. Mich., Foss. Corals, p. 14, pl. II., figs. 1 and 2.

Corallum hemispherical, turbinate or subpyriform, sometimes measuring 5 or 6 inches across. Corallites circular, at right angles to the surface, where they are slightly exsert, varying in diameter in the same and in different specimens from 2 to 3 mm.; they are separated from one another by spaces varying from 1 to about 5 mm. in width, but when crowded together in any part of the corallum they become almost contiguous. Septa twelve in number, in the form of carinae bearing stout spines extending half way or in some specimens almost to the centre of the corallites; in many specimens the carinae alone remain projecting slightly inward from the walls of the corallites. Interstitial spaces filled with vesicular structure made up of convex plates resting on each other and inclosing somewhat lenticular shaped cavities varying in width from 1 to 5 or 6 mm. Tabulae of the corallites horizontal, often rather irregular, two or three in a space of 1 mm. The edges of the calyces are slightly exsert, crenulated and decorated by a circle of twelve rounded tubercles; similar well marked tubercles occur on the surface between the calyces. It is only in well preserved specimens and ones in which the surface is not abraded that the tubercles are seen.

Occurs in the Niagara formation and in division I of the Anticosti group; in the Niagara, half a mile north-west of Portage Bay, Lake Manitou, Grand Manitoulin Island, Lake Huron, R. Bell, 1865, at Owen Sound, Ont., J. Townsend, 1882, on the Isle of Mann (Burnt Island), Lake Temiscaming, Que., A. E. Barlow, 1893; in division I of the Anti-

* See foot-note page 84.

costi group, Anticosti, at White and Junction cliffs, T. C. Weston 1865. A specimen labelled R. H, 1867, from the Guelph formation at Hespeler, Ont., is here doubtfully referred to this species; the specimen is a mould of the upper convex surface of a small corallum and shows the size and distance apart of the calyces.

One specimen from Lake Temiscaming, depressed turbinate in shape, $6\frac{1}{2}$ inches broad and 4 inches high.

LYELLIA EXIGUA, Billings. (Sp.)

Plate V., figs. 3, 3a.

Heliolites exiguus†, Billings. 1865. Canadian Naturalist, new series, vol. II., p. 42.
" " Billings. 1866. Cat. Sil. Foss. of Anticosti, p. 31, fig. 14.

Corallum subhemispherical, with a moderately convex upper surface and concave below; a concentrically wrinkled epitheca covers the basal surface. The type specimen, the only one representing the species in the collection, is 45 mm. long, 30 mm. broad and 13 mm. high. Corallites circular, 75 mm. wide, separated from each other by distances generally equal to or less than their width, but varying from 1 to 5 mm. wide. Tabulae of the corallites horizontal, from two to five occurring in a distance of 1 mm. The inner surface of the walls of the corallites is marked by twelve faint septal ridges, but whether these bore spines or not has not been determined. Spaces between the corallites filled with vesicles of rather unequal size, varying from about .16 to over .5 mm. in width. The surface of the corallum between the calyces has a granular appearance caused by the exposure of the vesicles through weathering. The edges of the calyces appear as rings slightly raised above the general level of the surface.

Gamache Bay, Anticosti, in division I. of the Anticosti group, T. C. Weston.

LYELLIA DECIPIENS, Rominger.

Lyellia decipiens, Rominger. 1876. Geol. Sur. Mich., Foss. Corals. p. 15, pl. III., fig. 1.

A single specimen from the Niagara formation of Grand Manitoulin Island, Lake Huron, collected by J. Townsend in 1883, is identified with this species; it is in the form of a small, somewhat discoidal mass, 3 inches across and a little over 1 inch high, rather flat above and convex below, where it apparently had an epithecal covering. The calyces are margined by a ring distinctly higher than the surface between the coral-

† See foot-note p. 84.

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Anticosti, p. 31, fig. 14.

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Corals, p. 15, pl. III.

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e between the coral-

lites, but in other respects it agrees with the description of Rominger's species, which is characterized as follows:—"Flat, undose expansions of laminated structure. Tubes one millimeter wide, orifices not projecting, crenulated by twelve marginal crests. Diaphragms slightly convex. Interstitial spaces usually larger than one tube diameter, their surface delicately reticulated by circumscribed cell spaces, as in *Heliolites*, but in vertical sections exhibiting a distinctly interlacing vesiculose structure, and not a tubular cœnenchym. Found in the Niagara group of Point Detour and Drummond Island (Lake Huron)."

This species differs from *Lyella exigua*, Billings, only in having larger corallites with larger intercalicular areas.

LYELLIA SUPERBA, Billings. (Sp.)

Plate V., figs. 4, 5 and 5a.

Trematopora superba, Billings. 1866. Cat. Sil. Foss. of Anticosti, p. 93.

Corallum forming flabellate or flattened narrow expansions with lobes or branches lying in the same plane, and with calyces on both sides as well as on the rounded edges. The corallum attains a breadth in the flabellate forms of 8 or 9 cent with a thickness of from 5 to 10 mm. Corallites circular, from .45 to about .6 mm. in diameter and at a distance from each other generally greater than their width, but varying from .5 to 1.5 mm. The corallites proceed outward from the central axial part and emerge at right angles to the surface, the circular margins of the calyces being slightly exsert. The spaces between the corallites are filled with vesicles of rather unequal size, varying from .25 to .75 mm. wide, those in the inner part being somewhat larger than those near the surface, making the structure near the surface more compact. Tabulæ are present between the corallites; they are horizontal, regularly disposed, about four occurring in a distance of 1 mm. Septa of the usual number, twelve, but little developed. The type specimen is 13 cent. high, broken at both ends, elliptical in transverse section, about 2 cent. broad throughout its length and about 8 mm. thick, with lobate outgrowths proceeding at an obtuse angle from the main part of the corallum.

A very strong resemblance exists between *Heliolites Grayi*, Milne-Edwards and Haime, judging from their description and figures, and *Lyella superba*, Billings. The former species was described as follows* "Corallum composite, dendroidal, forming lamellar sublobated expansions, both surfaces of which bear calices. These are placed at various distances

* Monograph of the British Fossil Corals, Milne-Edwards and Haime, 1850-1854, p. 252, pl. LVIII., figs. 1, 1a.

from each other (one, two, or three times their diameter), and are limited by a small, well-marked, circular ridge, formed by the exsert edge of 12 subequal thick septa. The canaliculæ of the cœnenchyma are somewhat irregular, and their parietes are rather thick. Diameter of the calices about one third of a line." The authors of this species referred it to the genus *Heliolites*, but the irregularity of the "canaliculæ of the cœnenchym" suggests the possibility of the spaces between the corallites being filled with vesicles rather than with tubules having tabulæ. If after further research this surmise prove correct, *Heliolites Grayi* would of necessity be removed to the genus *Lyellia* and the two species perhaps united under the older name, as the similarity between the two forms would then be such as to make this step expedient.

Occurs in the Niagara group of Ontario. The type specimen was collected at Cabot's Head, Georgian Bay, by Alexander Murray; other specimens are from lot 13, concession 7, Derby township, near Owen Sound, Ont., R. Bell, and from Owen Sound, J. Townsend, 1874.

GENUS LYOPORA, Nich. and Eth., jun., 1878.

Monogr. Sil. Foss. of Girvan, p. 25.

"Corallum composite, massive, composed of tubular, sub-cylindrical or hexagonal corallites, which are more or less completely fused with one another. Walls of the corallites extraordinarily thick and dense, destitute of mural pores. Columella absent. Septa rudimentary, few in number, having the form of irregular ridges on the interior of the wall. Tabulæ complete. No cœnenchyma." (Nich. and Eth., jun.)

LYOPORA GOLDFUSSI, Billings. (Sp.)

Plate V., figs. 6, 6a and 7.

Columnaria Goldfussi, Billings. 1868. Rep. of Progress for 1867, Geol. Survey of Canada, p. 166; and Canadian Naturalist, vol. III, p. 420.

Corallum hemispherical, subspherical or forming irregularly shaped rounded masses, sometimes as large as 2 or 3 inches high and 4 or 5 inches broad, composed of polygonal, subpolygonal or circular, moderately thick walled corallites that diverge upward and outward from the base and are in close or partial contact with each other. When the corallites are circular and only partially in contact, small interspaces of irregular shape and size are left between them; these are reduced to a minimum in size and number, or are absent when the corallites are polygonal and touch each other on all sides. The divisional lines between the walls of contiguous corallites

meter), and are limited by the exsert edge of 12 corallites. The corallites are somewhat cylindrical. Diameter of the calices varies from 1 to 2 mm. Species referred to the genus *Columnaria* "because of the corallites being filled with septa. If after further study it would of necessity be perhaps united under the name of *Protarea* forms would then be

The type specimen was found under Murray; other specimens from the township, near Owen Sound, 1874.

1878.

5. The corallites are sub-cylindrical or cylindrical, completely fused with one another, and dense, destitute of septa, few in number, and the wall. Tabulae

1887, Geol. Survey of Canada, vol. III, p. 420.

irregularly shaped corallites, 1 to 2 inches high and 1 to 2 mm. in diameter, polygonal or circular, and large upward and in contact with one another, only partially in contact, the size are left be- size and number, touch each other contiguous corallites

are frequently very obscure and difficult to see, although apparently a complete amalgamation does not take place. Corallites from about 1 to 2 mm. in diameter in different specimens, but often exhibiting a considerable variation in size in the same individual. Tabulae complete, flat or slightly concave, from four to six occurring in a space of 2 mm.; they are also apparently present in the interspaces, but a little closer together than those of the corallites. Septa twelve in number in mature corallites, in the form of longitudinal blunt ridges, equally developed and extending but a very short distance, about 2 mm. beyond the walls toward the centre of the corallites. The calyces are shallow, with the septa moderately distinct; the intercalicular spaces are also visible at the surface.

Hudson River formation.—At Snake Island (and loose) at Traverse Point, Lake St. John, Que., J. Richardson, 1857, at Wreck Point, Anticosti, Que., J. Richardson, 1856, and at Cape Smith, Lake Huron, R. Bell, 1859.

The smallest specimens from Lake St. John are not more than 1 inch or 1½ inch broad and 1 inch high, other specimens are intermediate in size between these and a large one that is 5 inches broad and nearly 3 inches high.

This species originally referred to *Columnaria*, has been assigned to the above genus, although it differs in having the walls of the corallites of only a moderate thickness, instead of being *extraordinarily* thick. In the Silurian Fossils of Girvan, pl. I., in the figures illustrating *L. favosa*, McCoy, sp. the great thickness of the walls is not so very apparent, especially in fig. 1a. In *L. Goldfussi* the septa are equal, always twelve in number, and the tubular spaces between the corallites form a marked feature of some of the specimens, viz., those in which the corallites are circular. These interspaces appear to have tabulae, a feature which, if taken with the cylindrical form of the corallites and the number of the septa, suggests an approach to the genus *Heliolites*. The retention of this species in the genus *Lyopora* would necessitate a slight amendment of the original generic description.

Genus PROTAREA, Milne-Edwards and Haime, 1851.

(Polyp. Foss. des Terr. Palæoz., p. 146.)

Corallum incrusting; corallites upright, opening at the surface in adjacent, shallow, rounded calyces; walls of the corallites not clearly defined; septa about twelve in number, stout, combining to form a thick pseudocolumella; interseptal spaces crossed by horizontal dissepiments; tubules occupying the spaces between the corallites, thick-walled, narrow, with numerous, complete, horizontal tabulae and without septa; calyces tuberculous at the centre and at the edge.

PROTAREA VETUSTA, Hall. (Sp.)

Plate V., figs. 8, 8a.

- Porites? vetusta*, Hall. 1847. *Fauna of New York*, vol. I., p. 71, pl. XXV., figs. 5a, 5b.
Protarea vetusta, Milne-Edwards and Haime. 1851. *Polyp. Foss. des Terr. Paléoz.*, 1851, pl. 14, figs. 6, 6a.
Heliolites tenuis, Billings. 1865. *Canadian Naturalist*, new series, vol. II., p. 428.
 " " Billings. 1866. *Cat. Sil. Foss. of Anticosti*, p. 32.
Protarea vetusta, Nicholson. 1875. *Fauna of Ont.*, p. 9 and *Geol. Surv. of Ohio*, vol. II., p. 221.

Corallum thinly incrusting, with a thickness of from 1 to 3 mm., covering an area 2 or 3 inches across; by the growth of one layer upon another a thickness of about 10 mm. may be attained. Calyces shallow circular or subpolygonal, from 1 to 1.5 mm. in diameter, nearly touching or from .5 to 1.5 mm. apart, with twelve stout septa whose inner ends combine to form a pseudocolumella having the appearance at the bottom of the calyces of a number of tubercles. Between the calyces at the surface are numerous subpolygonal openings, from one to five or six in a straight line between adjacent calyces; these become contracted a little below the surface and are continued vertically downward as parallel narrow tubes with thick walls. The structure, as seen in longitudinal sections immediately below the calyces, is obscure and not definitely defined from the surrounding tubules, but the spaces between the septa are apparently crossed by independent transverse dissepiments which are not of the nature of true tabulae. The tubules are crossed by horizontal tabulae at rather close intervals. The rounded, exsert ends of the septa at the edges of the calyces, together with the tubercles at the bottom of the calyces and the presence often of tubercles in the intercalicular areas, give the surface of the corallum a granular appearance.

Occurs in the Trenton formation at and in the vicinity of Ottawa, Ont., in division I of the Anticosti group, Anticosti, and in the Hudson River formation in Manitoba. The specimens in the possession of the Geological Survey were collected at Ottawa by Dr. Van Cortlandt, at Ottawa, by H. M. Ami, 1882, and on the Castor River near Castleman, county of Russell, Ont., 1884, near Douglas, county of Renfrew, Ont., 1896, by R. W. Ells and L. M. Lambe, those from Anticosti at Junction Cliff by T. C. Weston, 1865. Nicholson mentions its occurrence (op. cit.) in the Trenton limestone at Peterborough, Ont. The specimens described by Hall are from the lower part of the Trenton formation at Watertown, Jefferson county, New York. It has been recognized from the lower beds of the Hudson River formation at Stony Mountain, Manitoba, by Mr. Whiteaves, but is not known to occur elsewhere at this horizon in Canada, although it appears to be a not uncommon fossil in the Cincinnati group

[LAMBE.]

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of Ohio. Mr. Whiteaves has also recognized it from the Galena-Trenton of Lake Winnipeg.

PROTAREA VETUSTA, var. *MAGNA*, Whiteaves.

Protarea vetusta, var. *magna*, Whiteaves. 1897. Contr. to Can. Palæon, vol. III., pt. 3, p. 155, pl 18, figs. 2, 3, 3a.

From the Galena-Trenton of Lower Fort Garry, Manitoba, R. Bell, 1880, and T. C. Weston, 1884.

GENUS *STYLARÆA*, Von Seebach, 1866.

(Zeitschr. d. deutsch. Geol. Ges., Bd. XVIII., p. 304.)

"Corallum composite, the sclerenchyma traversed by numerous fine inosculating canals. Corallites short, opening on the surface by rounded or polygonal calices, of moderate depth. Septa in the form of a variable number of short blunt ridges extending into the interior of the visceral chamber, the axis of which is occupied by a well developed circular or oval columella, which the septa do not nearly reach. Strong and complete tabulæ present or absent. Corallum encrusting, or (?) attached only at a single point." (Nicholson.)

STYLARÆA PARVA, Billings. (Sp.)

Plate 5, figs. 9, 9a and 9b.

Columnaria parva, Billings. 1859. Canadian Naturalist, vol. IV., p. 428.

? *Stylaræa occidentalis*, Nich. and Eth., jun. 1878. Sil. Foss. of Girvan, p. 62, pl. IV., figs. 2, 2a, 2b.

Corallum thinly incrusting, from 1 to 5 or 6 mm. thick, forming flat expansions, with well marked, sunken, shallow calyces, on the upper surface; the single specimen* in the collection is convex above, measures about 6.5 cent. across and has a maximum thickness of 16 mm., attained by the succession of five layers of growth the one over the other. Corallites polygonal or subcircular, with thick walls and an average width of .75 mm., either in contact or up to a distance of half their width apart. The centre of the corallites is occupied by a cylindrical, rod-like, columella which appears at the bottom of the calyces as a prominent rounded

* Although there is only one specimen now representing this species in the collection, Mr. Billings evidently had several specimens, as he states that the "species occurs in large, globular, irregular, pyriform or wide depressed convex masses," and further adds that "some of the flattened masses appear to have been more than one foot wide, and often they have a thin stratified structure or are composed of successive layers, the divisional planes between which divide the corallites at right angles."

tubercle. Tabulæ numerous, horizontal, at regular intervals apart of .5 mm. Septa, sixteen in number, alternately long and short, the longer passing half way to the centre and apparently not reaching the columella, the smaller septa seen only in transverse sections and not recognizable in the calyces. When the walls of the corallites are not in actual contact the interstitial spaces are apparently filled with coenenchymal tissue, the exact structure of which has not been clearly ascertained although in transverse sections it appears to be obscurely reticulated by faint linear markings.

Chazy limestone.—Mingan Islands, Que., W. E. Logan and J. Richardson, 1856.

The similarity between the fossil from the Mingan Islands, described by Billings, and *Stylarcea occidentalis*, Nich. and Eth. jun., from the lower Silurian rocks of the Girvan district in Ayrshire, Scotland, is obvious to any one comparing the above description with the published one of the latter species; that they are specifically identical is probable, but not having seen actual specimens of the Girvan fossil the writer is unwilling to assert positively that they belong to the same species.

Dr. Nicholson refers (op. cit. p. 95) the Craighead limestone near Girvan and its associated shales from which *S. occidentalis* was obtained, to a "tolerably low position in the Lower Silurian series, corresponding perhaps with the upper part of the Trenton limestone or the base of the Cincinnati and Hudson River formations of North America," and mentions being struck with "the strongly *American facies* of the Craighead corals and in particular their resemblance to those of the Trenton and Cincinnati groups."

TETRADIIDÆ.

Genus TETRADIUM, Dana. 1846.

(Wilkes's Exped. Zoophytes, p. 701.)

Corallum massive, composed of long, upright intimately united, thin walled corallites that have a quadrangular or petaloid transverse section; septa springing from the centre of the walls, lamellar, stout at the base, thin towards the edge, typically four in number, reaching about half way to the centre of the visceral chamber; secondary septa frequently present near the angles, raising the total possible number to twelve; tabulæ numerous, complete, horizontal; increase by fission of the corallites.

TETRADIUM FIBRATUM, Safford.

Plate II., fig. 5.

Tetradium fibratum, Safford. 1856. Am. Jour. Sci. and Arts, vol. XXII., p. 237.

Tetradium minus, Safford. 1856. Ibid, vol. XXII., p. 238.

Tetradium apertum, Safford. 1856. Ibid, vol. XXII., p. 238.

Tetradium fibratum, Billings. 1863. Geology of Canada, pp. 136, 137, 139, fig. 71a, and pp. 141, 149, 163, 177, 178, 185, 186, 194, 195, 218 and 238.

" " Nicholson. 1875. Palæon. of Ont. p. 10.

Tetradium minus Nicholson. 1875. Palæon. of Ont. p. 28.

Tetradium Huronense, Foord, in parte. 1883. Contr. to Can. Cambro-sil. micro-pal. p. 25, pl. VII., figs. 1b, 1c, 1d, 1e, (not 1a).

Tetradium fibratum, Safford, the type of the genus, is described as having a corallum which is "massive, hemispherical, or flattened hemispherical, composed of diverging tubes. Cell tubes four-sided with thin and slightly rugose walls; the four lamellæ distinct, nearly reaching the centre of the tubes; breadth of full-grown tubes usually about, or but little more than half a line, varying occasionally from $\frac{1}{3}$ rd to $\frac{2}{3}$ ths of a line. Transverse septa usually absent. A few have been seen in one specimen, which were about twice the breadth of a tube apart." From the upper half of the Lower Silurian rock of Middle Tennessee (Hudson River).

Tetradium minus was characterized by Safford as having smaller corallites than *T. fibratum*, viz., from $\frac{1}{4}$ th to $\frac{1}{3}$ rd of a line in breadth. No other distinguishing characters were given. This fossil was collected in the rocks of the upper division of the Lower Silurian series of Middle Tennessee (Hudson River).

Nicholson, in his Palæontology of Ontario, p. 28, expresses a doubt as to whether specimens of *T. minus** from the Hudson River of the River Credit, Ont., and at Manitouaning, Grand Manitoulin Island, are really distinct from *T. fibratum*, as described by Safford.

In Canada *Tetradium* is found at many localities in rocks of the Birds-eye and Black River formation. The corallites in these specimens are of rather unequal size, varying in specimens from different localities from $\frac{1}{4}$ th to $\frac{2}{3}$ ths of a line in width, and in individual specimens from $\frac{1}{3}$ rd to $\frac{2}{3}$ ths, from $\frac{1}{4}$ th to about $\frac{1}{2}$, and from $\frac{1}{4}$ th to $\frac{1}{3}$ rd of a line in breadth; a specimen from Gloucester Co., near Ottawa, has corallites with an average width of $\frac{1}{2}$ a line. The septa in some specimens reach nearly to the centre of the corallites, in others they are not so highly developed. The tabulæ are seldom seen in longitudinal sections.

*Nicholson in his Palæozoic tabulate corals, p. 232, and in his manual of Palæontology, vol. I, p. 341, apparently regards *T. minus* as the type of the species. As *T. fibratum* was described by Safford before his other species of *Tetradium*, it may be presumed that the founder of the species looked upon *T. fibratum* as the type.

Specimens of *Tetradium* have been collected from the Hudson River formation at Cape Smyth, Lake Huron, and at Streetsville, Ont., these have corallites varying in width from $\frac{1}{4}$ rd to $\frac{1}{2}$ of a line. The tabulae in these specimens are as a rule preserved; they are flat and from four to ten occur in a space of 1 line. The septa show the same variation in development as is found in those of the Birdseye and Black River specimens, and the corallites also vary in size to some extent in individual specimens.

A specimen of *Tetradium* collected by Prof. J. H. Panton from rocks of Galena-Trenton age at East Selkirk,* Manitoba, has corallites of rather unequal size, varying in width from not quite $\frac{1}{4}$ th to $\frac{1}{2}$ of a line. The tabulae are delicate, flat and placed about $\frac{1}{4}$ th of a line apart. The septa extend only a very short distance from the walls of the corallites towards the centre.

If in *T. fibratum* the corallites vary in width from $\frac{1}{4}$ th to $\frac{3}{4}$ ths of a line, and in *T. minus* from $\frac{1}{4}$ th to $\frac{1}{2}$ rd of a line, and that this constitutes the sole difference between the two species, then it would be difficult to tell to which of these species many Canadian specimens from the above mentioned horizons belong, as the majority of those examined have corallites that range in width from $\frac{1}{4}$ th to $\frac{1}{2}$ of a line.

The writer has not observed any differences in structure in Canadian specimens of this coral that are, in his opinion, sufficient to warrant a specific or even a varietal subdivision; they are therefore here referred to under the name *T. fibratum*.

In his "Contributions to the Micro-palaeontology of the Cambro-Silurian rocks of Canada" Mr. A. H. Foord has described under the name *T. Huronense* two distinct forms, one the *Stenopora Huronensis* of Billings, since found to be a *Labechia*, the other *T. fibratum*, Safford. The specimens referred to and figured by Foord are in the museum of the Geological Survey, and are from the Hudson River formation at Cape Smyth, Lake Huron. The specimen represented in plate VII, fig. 1, of Mr. Foord's paper, is a mass of *T. fibratum* coated* to a thickness of from about 11 to 2 lines by *Labechia Huronensis*, Bill. Figure 1a is a representation of a portion of a mass of *Labechia Huronensis* and figs. 1b, 1c, 1d, 1e illustrate the structure of *T. fibratum* (poorly preserved) as seen in horizontal and longitudinal sections, taken from the specimen shown in fig. 1.

* This specimen was received as a donation from the Peter Redpath Museum through Sir J. William Dawson, and had previously been recognized as *Tetradium fibratum* by Prof. Panton and Mr. Whiteaves.

from the Hudson River at Streetsville, Ont., that of a line. The tabulae are flat and from four to show the same variation in the Birdseye and Black River specimens to some extent in individual

J. H. Pantou from rocks at Streetsville, Ont., has corallites of rather than $\frac{1}{4}$ th to $\frac{1}{2}$ of a line. The septa are $\frac{1}{4}$ th to $\frac{1}{2}$ of a line apart. The septa of the corallites toward from $\frac{1}{4}$ th to $\frac{3}{4}$ ths of a line, that this constitutes the could be difficult to tell from the above mentioned specimens examined have corallites

n structure in Canadian, sufficient to warrant a therefore here referred to

of the Cambro-Silurian described under the name *Strophomena Huronensis* of *T. fibratum*, Safford. In the museum of the Huron formation at Cape in plate VII, fig. 1, of * to a thickness of from Bill. Figure 1a is a *Huronensis* and figs. 1b, (poorly preserved) as en from the specimen

Redpath Museum through as *Tetradium fibratum* by

A number of specimens from the Birdseye and Black River formation at Pakenham, Ont., and in the township of McNab, Ont., show the corallites, on a weathered surface, strewn about separately or in fascicles. Mr. Billings referred these to *T. fibratum* and they are labelled as such in the museum. The fossil in this state of preservation is very probably what Safford named *T. apertum*: the separation of the corallites of *T. fibratum*, perhaps after the death of the colony, from each other, or the division of the corallum into small bundles or fascicles of corallites might give a result such as is found in these specimens.

In the Geology of Canada, 1863, mention is made of *Tetradium fibratum* as occurring in the Birdseye and Black River formation in the vicinity of Montreal, Que.; at Pointe Claire and Joliette, Que.; at Les Écorchés, near Murray Bay, Que.; at Vanlavin's Mills in Storrington township, county of Frontenac, Ont., and in Loughborough township of the same county; in Marmora township, county of Hastings, Ont., and on La Cloche, Thessalon and Campement d'Ours Islands, Lake Huron. In the same report its occurrence in the Hudson River formation at Cape Smyth, Lake Huron is referred to.

The size of the corallites of specimens from the following localities are:

Formation.	Locality.	Size of Corallites.
Birdseye & Black River.	Plantagenet township, Prescott county. J. Richardson, 1860.	Over $\frac{1}{2}$ to $\frac{3}{4}$ of a line; irregular in size.
	McNab township, Renfrew county. J. Richardson, 1863.	$\frac{1}{2}$ to $\frac{3}{4}$ of a line; irregular in size.
	Pakenham township, Lanark county. J. Richardson, 1863.	Over $\frac{1}{2}$ to $\frac{3}{4}$ of a line; irregular in size.
	(Gravel Point, St. Joseph's Island, Lake Huron. T. C. Weston, 1882.	$\frac{1}{2}$ to $\frac{3}{4}$ of a line; irregular in size.
	West Shore Great Manitou Island, Lake Nipissing. A. E. Barlow, 1894.	$\frac{1}{2}$ to $\frac{3}{4}$ of a line; irregular in size.
	Gloucester township, Carleton county. W. R. Billings, 1895.	Average $\frac{1}{2}$ of a line; rather regular in size.
	Pauquette's Rapids, Ottawa River.....	Over $\frac{1}{2}$ to over $\frac{3}{4}$ of a line; irregular in size.
	Ottawa, O. T. C. Weston, 1886.....	$\frac{1}{2}$ to $\frac{3}{4}$ of a line; irregular in size.
	Pointe Claire, Que. N. J. Giroux, 1895	$\frac{1}{2}$ to $\frac{3}{4}$ of a line; irregular in size.
	East Selkirk, Man. J. H. Pantou.....	Not quite $\frac{1}{2}$ to $\frac{3}{4}$ of a line; irregular in size.
Galena-Trenton....	Cape Smyth, Lake Huron. R. Bell, 1869.	$\frac{1}{2}$ to $\frac{3}{4}$ of a line; irregular in size.
Hudson River....	Cape Smyth, Lake Huron. R. Bell, 1869. (Coated with Labechia.)	Average about $\frac{1}{2}$ of a line.
	Credit River, Streetsville, O. J. B. Tyrrell, 1888.	Average not quite $\frac{1}{2}$ of a line.

* Ann. and Mag. Nat. Hist. 5th Series, vol. XVIII, p. 18. 1886.

In the above mentioned specimen from Pointe Claire, the corallites show the usual four septa extending toward the centre, but at times also secondary ones proceeding from the main wall one to each space between the primary septa and the angles of the tube wall. A corallite in which these secondary septa are developed suggests a stage of growth preparatory to its division into four smaller ones, and strengthens the idea that the manner of increase of the corallum was by fission of the old tubes. When by the union of the primary septa young corallites were formed, the secondary septa became in turn primary ones in the new corallites, in which septa were probably also developed on the newly completed septal walls. At a certain stage of growth it is thus seen that a corallite may have as many as twelve septa, four of them being primary and eight secondary.

April, 1897.

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PLATE I.

FAVOSITES GOTHLANDICA, Lamarck (page 3).

- Figure 1. Side view of a corallite from a specimen from l'Anse à la Vieille, Baie des Chaleurs, showing the mural pores, tabulae and septal spines; for greater clearness the tabulae are omitted from the central part and the septal spines from the upper part of the figure. Five times the natural size.

FAVOSITES ASPERA, d'Orbigny (page 4).

- Figure 2. Side view of a corallite from a specimen from Stonewall, Manitoba; as in figure 1 the septal spines and tabulae are not shown together. Magnified five times.

FAVOSITES BASALTICA, Goldfuss (page 8).

- Figure 3. Representation of the arrangement of the tabulae and squamulae in the interior of a corallite of a specimen from the Corniferous limestone of Ontario; the tabulae alone are shown in the upper part of the figure. Enlarged five times.

- Figure 3a. A few corallites from the same specimen as seen from above, showing complete tabulae in some of the corallites. Enlarged five times.

CÆNITES SELWYNI, Nicholson (page 28).

- Figure 4. Portion of the upper surface of a specimen from Hagarville, Ontario. Five times the natural size.

- Figure 4a. Vertical section of the same specimen. Enlarged five times.

CLADOPORA CRYPTODENS, Billings (page 31).

- Figure 5. Side view of a few calyces of a specimen from the Corniferous limestone of Ontario. Enlarged five times.

- Figure 5a. Corallites from the same specimen, as seen in transverse section immediately below the calyces and showing the three septal ridges. Five times the natural size.

CALAPECIA CANADENSIS, Billings (page 43).

- Figure 6. Longitudinal section of portion of a specimen from Lower Fort Garry, Manitoba; three corallites are here represented with a space crossed by diaphragms separating two of them. Enlarged two and one half times.

- Figure 6a. Transverse section from the same specimen, similarly enlarged.

- Figure 7. A rather diagrammatic representation of the interior of a corallite of a specimen from Lower Fort Garry, Manitoba; the tabulae are purposely left out. Five times the natural size.

FLETCHERIA INCERTA, Billings (page 48).

- Figure 8. Transverse section of portion of a specimen with cylindrical corallites from St. Charles Island, Mingan Islands, Gulf of St. Lawrence. Enlarged five times.

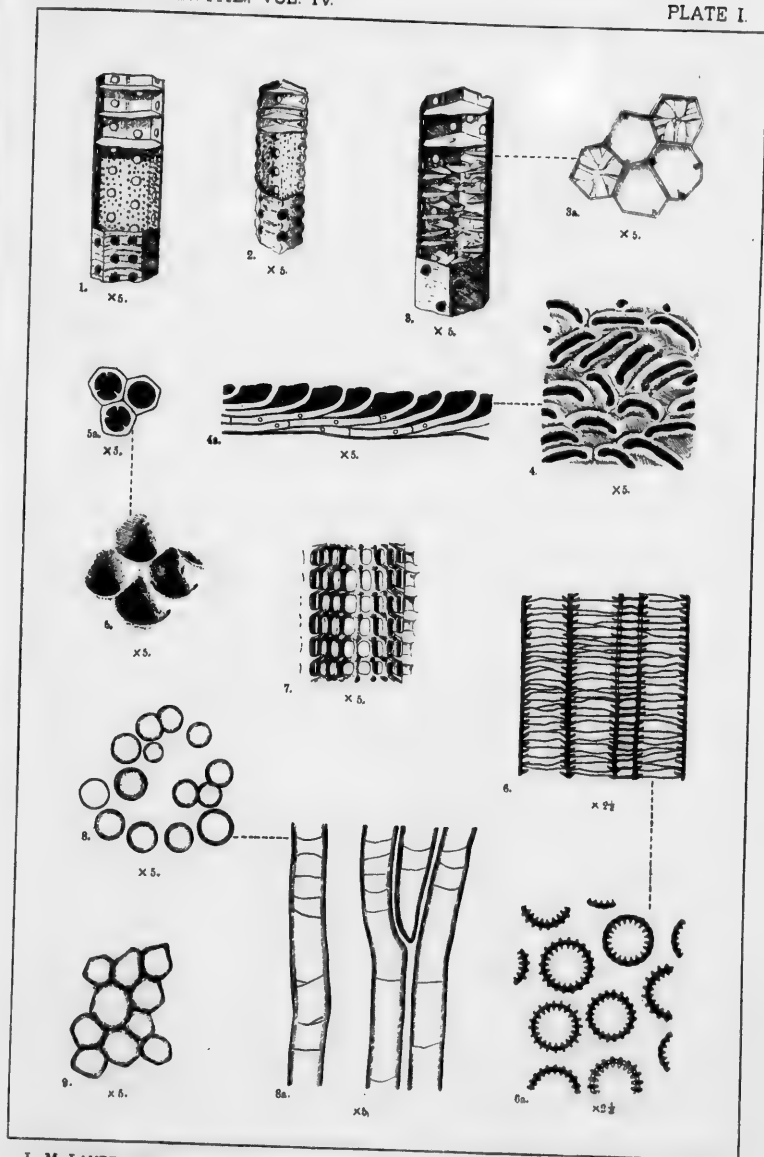
- Figure 8a. Longitudinal section of a few corallites from the above specimen, similarly enlarged.

- Figure 9. Transverse section of a portion of a specimen, with polygonal corallites, from the same locality. Five times the natural size.

Geological Survey of Canada.

CONTR. TO CAN. PAL. VOL. IV.

PLATE I.



L. M. LAMBE, DELT.



PLATE II.

NYCTOPORA BILLINGSII, Nicholson (page 49).

Figure 1. Transverse section, enlarged five times, of corallites of a specimen from Peterborough, Ontario.

Figure 1a. Longitudinal section of corallites of the same. Magnified five times.

SYRINGOPORA DALMANII, Billings (page 51).

Figure 2. Side view of part of a corallum from Lake Temiscaming, Que. Natural size.

SYRINGOPORA RETIFORMIS, Billings (page 52).

Figure 3. Side view of part of a specimen from the township of Derby, county Grey, Ontario, Natural size.

SYRINGOPORA PERELEGANS, Billings (page 56).

Figure 4. View of the under side of a part of the leaf-like basal expansion of a specimen from the Corniferous limestone of Ontario. Natural size.

TETRADIMUM FIBRATUM, Safford (page 93).

Figure 5. Transverse section of a few corallites that show secondary septa; from Pointe Claire, Island of Montreal. Magnified thirteen times.

HELIOLITES INTERSTINCTA, L. (page 79).

Figure 6. Transverse section of corallites in a specimen from west of l'Anse à la Barbe, Baie des Chaleurs. Five times the natural size.

Figure 6a. Longitudinal section of the same, similarly magnified.

HELIOLITES SUBTUBULATA, McCoy (page 80).

Figure 7. Transverse section from a specimen from l'Anse à la Vieille, Baie des Chaleurs. Enlarged five times.

Figure 7a. Longitudinal section of the same. Enlarged five times.

PLASMOPORA FOLLIS, Milne-Edwards and Haime (page 82).

Figure 8. Transverse section of a few corallites of a specimen from one mile east of the mouth of the Little Cascapedia River, Baie des Chaleurs. Magnified five times.

Figure 8a. Longitudinal section of the same also magnified five times.

PLASMOPORA PETALIFORMIS, Lonsdale (page 83).

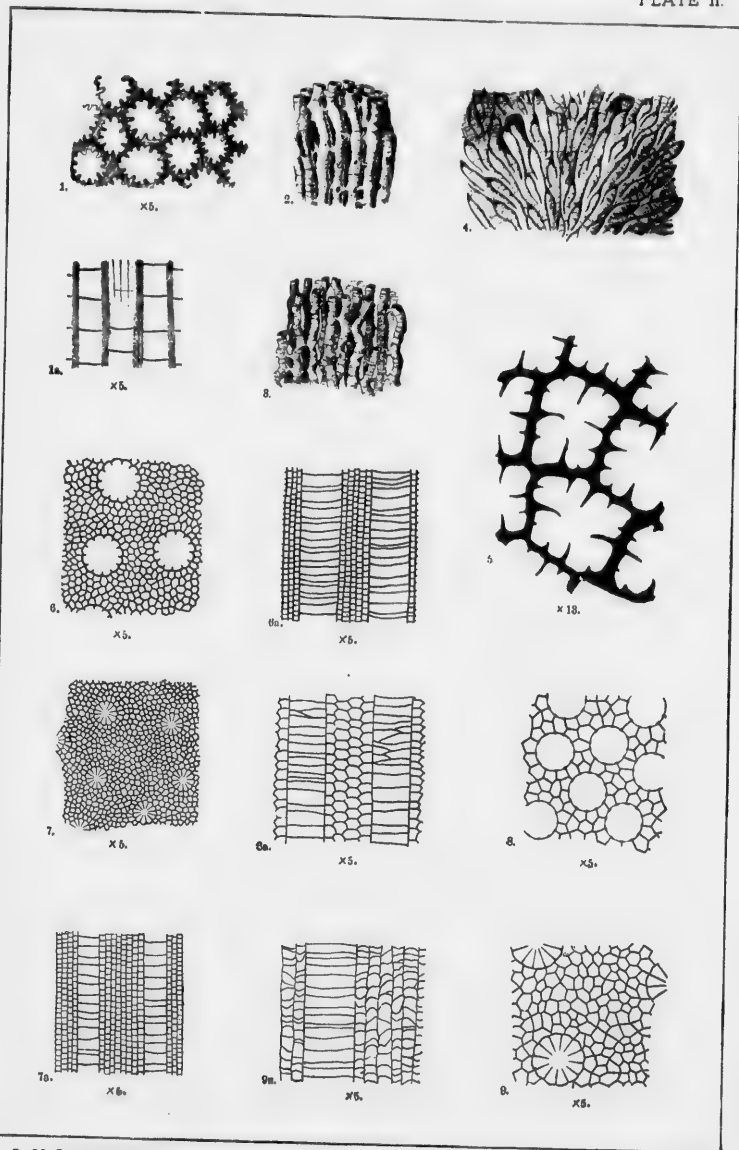
Figure 9. Transverse section of corallites of a specimen from two miles west of Chicotte River, Anticosti. Five times enlarged.

Figure 9a. Longitudinal section of the same. Five times the natural size.

Geological Survey of Canada.

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PLATE II.



L. M. LAMBE, DELT.

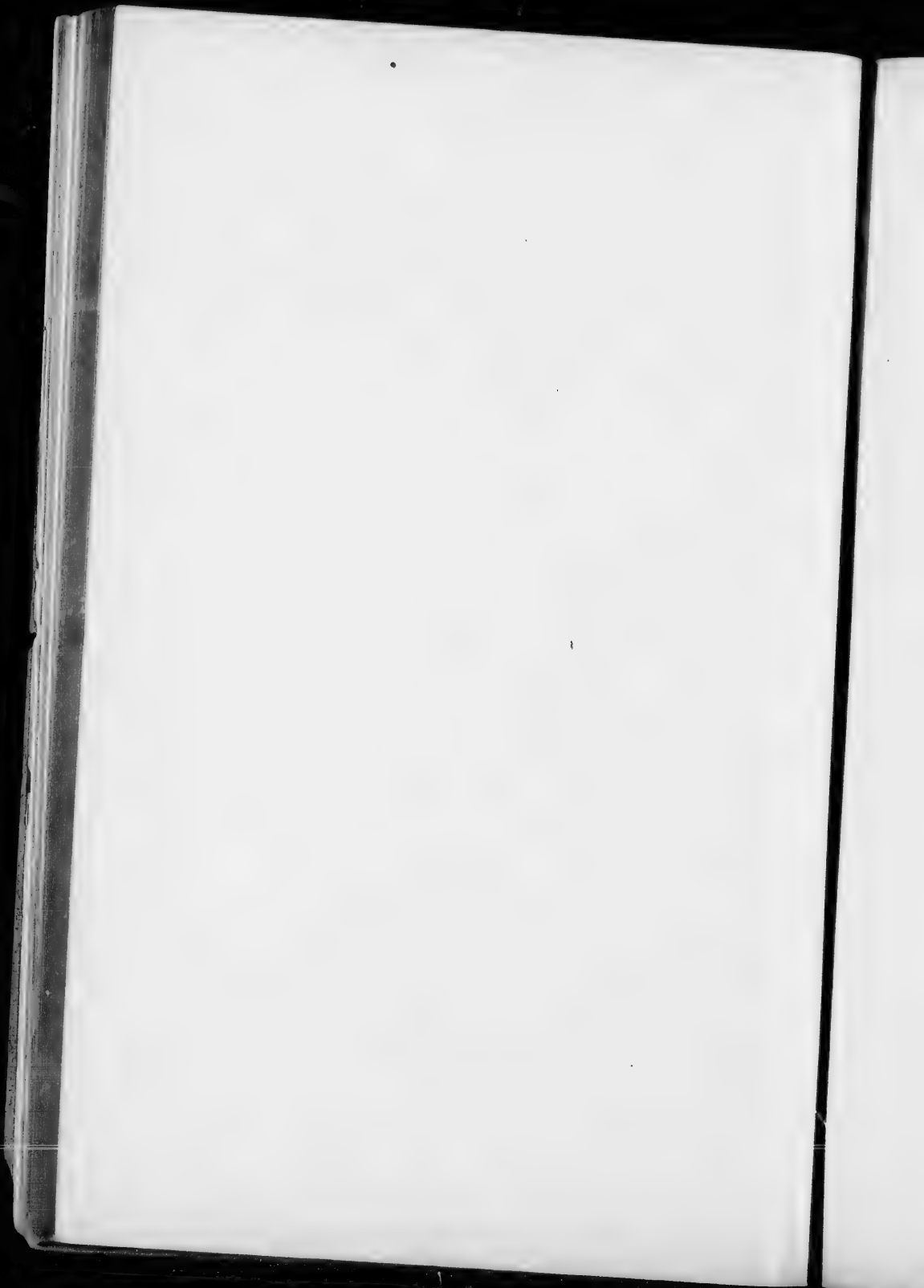


PLATE III.

HALYSITES CATENULARIA, L. (page 68).

- Figure 1. Portion of an average specimen from Lake Temiscaming, Que., with corallites of average size. Natural size.
- Figure 1a. Transverse section of two corallites of the same, showing the position of the tubules. Enlarged five times.
- Figure 1b. Corallites and tubules of the same, as seen in longitudinal section. The tubules of the tubules are strongly arched whilst those of the corallites are generally flat or slightly concave. Enlarged five times.
- Figure 2. Portion of a specimen from the Niagara of Ontario with corallites that are almost circular. Natural size.
- Figure 2a. Transverse section of two corallites of the same showing the septal spines and the tubules. A longitudinal section of these corallites is similar to what is shown in fig. 1b. Enlarged five times.
- Figure 3. A natural longitudinal section of a specimen from the Guelph formation of Ontario. Natural size.
- Figure 3a. Transverse section of the corallites of the same. Natural size.

HALYSITES CATENULARIA, var. MICROPORA, Whitfield (page 70).

- Figure 4. Portion of a specimen from the Niagara of western Ontario showing a marked irregularity in the shape of the meshes. Natural size.

HALYSITES CATENULARIA, var. GRACILIS, Hall (page 69).

- Figure 5. The general form and arrangement of the corallites as seen in a specimen from East Selkirk, Man. Natural size.
- Figure 5a. Corallites of the same, as seen in transverse section. Enlarged five times.
- Figure 5b. Corallites of the same, viewed in longitudinal section. The septal spines on the sides of the corallites appear as dots. Five times the natural size.
- Figure 6. Portion of a specimen from Jack Head Island, Lake Winnipeg, in which the corallites are large and more than usually angular. Natural size.
- Figure 7. Part of a specimen from Churchill Harbour, Hudson Bay, with very small corallites. Natural size.

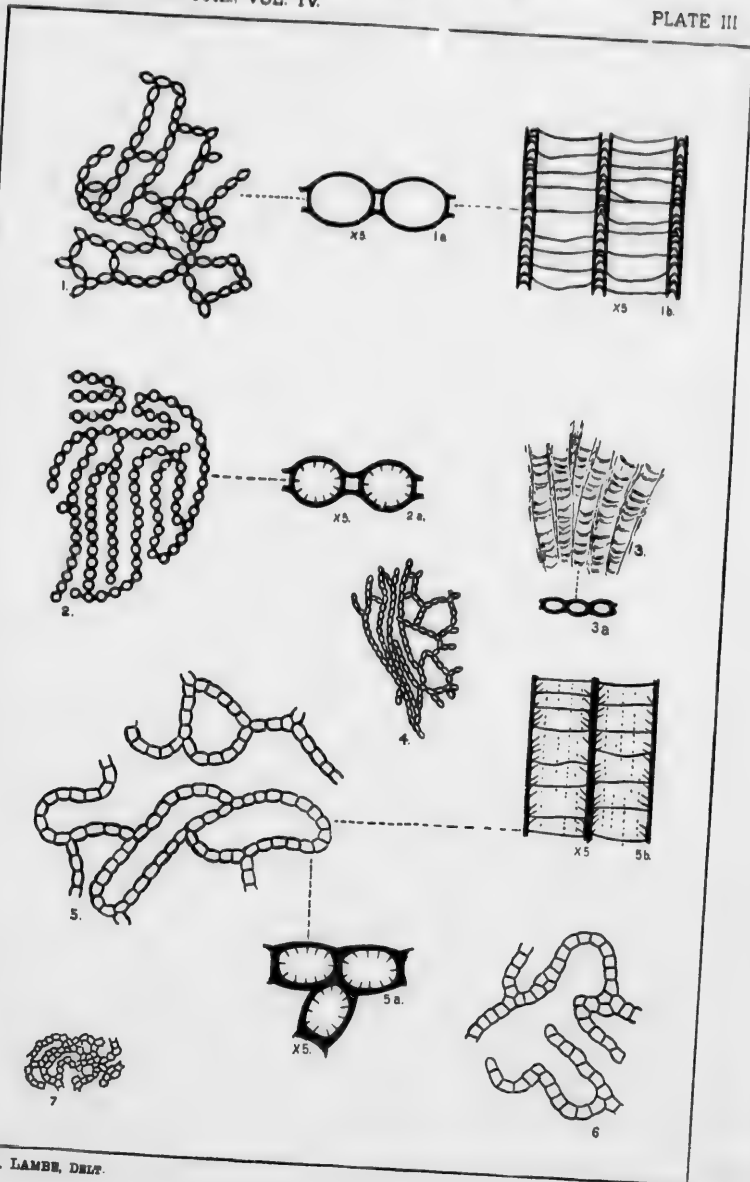




PLATE IV.

HALYSITES CATENULARIA, var. QUEBECENSIS (page 69).

- Figure 1. A few meshes, showing the general arrangement of the corallites, of a large specimen from Lake St. John, Que., two miles south of Blue Point. Natural size.
 Figure 1a. Transverse section of two corallites of the same. Five times the natural size.
 Figure 1b. Longitudinal section of the same, showing the tabulae in the corallites and tubules. Enlarged five times.

HALYSITES CATENULARIA, var. NITIDA (page 71).

- Figure 2. The shape of the meshes in a portion of a specimen from L'Anse à la Barbe, Baie des Chaleurs, Que. Natural size.
 Figure 2a. Transverse section of corallites and tubules of the same, showing their relative size. Enlarged five times.
 Figure 2b. Longitudinal section of the same showing the tabulae and septal spines. Enlarged five times.

HALYSITES CATENULARIA, var. SIMPLEX (page 70).

- Figure 3. Transverse section of two corallites of a specimen from near the mouth of the Little Cascapedia River, Que. Five times the natural size.
 Figure 3a. Longitudinal section of the same. Enlarged five times.

HALYSITES CATENULARIA, var. AMPLITUBULATA (page 71).

- Figure 4. Transverse section of two corallites and a tubule of a specimen from L'Anse au Gascon, Baie des Chaleurs, Que., showing the great development of the latter. Enlarged five times.
 Figure 4a. Longitudinal section of the same showing the tabulae of the corallites and tubule. Enlarged five times.

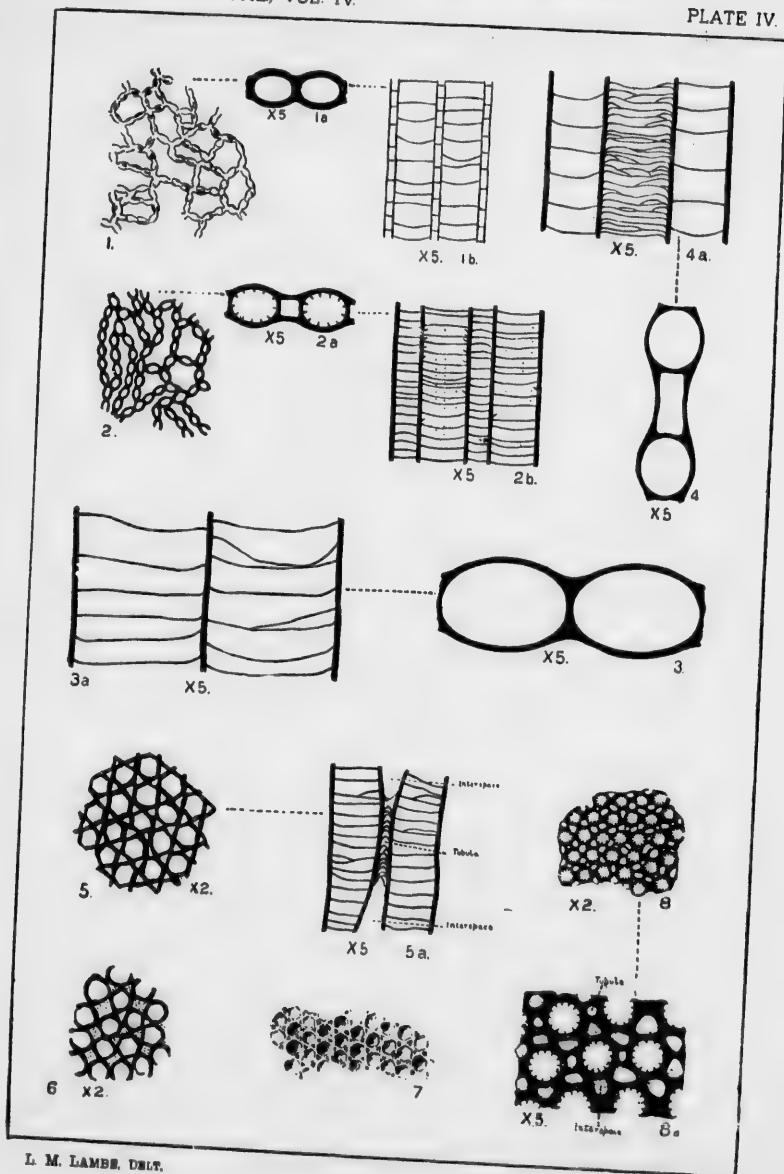
HALYSITES COMPACTA, Rominger (page 71).

- Figure 5. General arrangement of the corallites as seen in a specimen from the north end of Lake Temiscaming, Que., showing the triangular interspaces. Twice the natural size.
 Figure 5a. Longitudinal section of two corallites and a tubule of the same; the section does not lie exactly in the plane of the tubule, and shows an interspace on either side. Enlarged five times.
 Figure 6. Portion of a specimen, from the same locality as the above, with nearly circular corallites and comparatively large interspaces. Twice the natural size.
 Figure 7. View of the weathered surface of a specimen from the north-east side of the Columbia River, B.C. Natural size.
 Figure 8. Arrangement of the corallites, tubules and interspaces in a specimen from the Isle of Mann (Burnt Island), Lake Temiscaming, Que. Twice the natural size.
 Figure 8a. The same enlarged; five times the natural size.

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PLATE IV.



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PLATE V.

LYELLIA AFFINIS, Billings (page 84).

- Figure 1. Transverse section of part of a specimen from three miles west of Jupiter River, Anticosti. Magnified five times.
Figure 1a. Longitudinal section of the same. Enlarged five times.

LYELLIA AMERICANA, Milne-Edwards and Haime (page 85).

- Figure 2. Corallites, as seen in transverse section, in a specimen from Grand Manitoulin Island, Lake Huron. Five times the natural size.
Figure 2a. Longitudinal section of the same. Five times the natural size.

LYELLIA EXIGUA, Billings (page 86).

- Figure 3. Horizontal section showing the disposition of the corallites in a specimen from Gamache Bay, Anticosti. Enlarged five times.
Figure 3a. Longitudinal section from the same specimen, also enlarged five times.

LYELLIA SUPERBA, Billings (page 87).

- Figure 4. Type specimen from Cabot's Head, Georgian Bay. One half the natural size.
Figure 5. Transverse section from a specimen from Owen Sound, Ontario. Five times the natural size.
Figure 5a. Longitudinal section of the same. Enlarged five times.

LYOPORA GOLDFUSSI, Billings (page 88).

- Figure 6. Transverse section from a specimen from Snake Island, Lake St. John, Que., showing polygonal corallites. Five times the natural size.
Figure 6a. Longitudinal section of the same, also magnified five times.
Figure 7. Transverse section from a specimen from the same locality, showing circular corallites. Enlarged five times.

PROTAREA VETUSTA, Hall (page 90).

- Figure 8. Transverse section, a little below the surface, in a specimen from Ottawa, Ontario. Enlarged five times.
Figure 8a. Longitudinal section of the same showing a calyx with the pseudocolumella occupying the centre of the corallite. Enlarged five times.

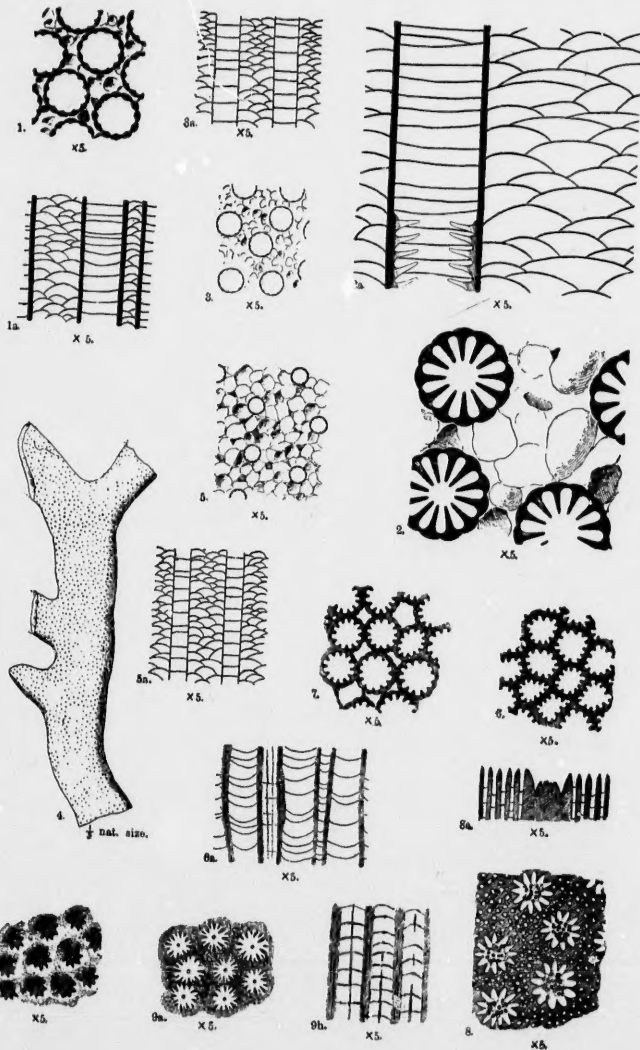
STYLARÆA PARVA, Billings (page 91).

- Figure 9. Part of the upper surface of a specimen from the Mingan Islands, Gulf of St. Lawrence. Enlarged five times.
Figure 9a. Transverse section from the same specimen. Magnified five times.
Figure 9b. Longitudinal section from the same, likewise enlarged five times.

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PLATE V.



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